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THESIS

**ANALYSIS OF SELECT MILITARY OCCUPATIONAL
SPECIALTY SCHOOLS IN THE MARINE CORPS
ENLISTED ENTRY-LEVEL TRAINING PIPELINE**

by

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March 2011

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**ANALYSIS OF SELECT MILITARY OCCUPATIONAL SPECIALTY SCHOOLS
IN THE MARINE CORPS ENLISTED ENTRY-LEVEL TRAINING PIPELINE**

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ABSTRACT

The Marine Corps Enlisted Entry-Level Training (EELT) pipeline is a complex system responsible for transforming civilians into Marines capable of performing a myriad of tasks required to sustain the Marine Corps. This report provides a detailed process description and throughput analysis of four Military Occupational Specialty (MOS) schools. This description and analysis is performed using process analysis techniques found within the Operations Management (OM) discipline of study to determine structural and procedural inefficiencies within the system responsible for delayed throughput times and increased costs. This report offers analysis of course capacity, course and class utilization rates, annual and trimester student throughput forecast errors, and a cost estimation of delays within the EELT pipeline. Additionally, observations of the Training Input Plan and two different information technology systems used within this system are provided. This report concludes by offering six process improvement recommendations that provide the opportunity to increase efficiency in the EELT pipeline.

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LIST OF ACRONYMS AND ABBREVIATIONS

2/11	2 nd Battalion, 11 th Marine Regiment
5/14	5 th Battalion, 14 th Marine Regiment
ASC	Administrative Specialist Course
ASR	Authorized Strength Report
ATRRS	Army Training Requirements and Resources System
BFTC	Basic Finance Technician Course
EELT	Enlisted Entry-Level Training
ELR	Entry Level Receiving
FLC	Formal Learning Center
FMAM	February, March, April, May
FMRAC	Financial Management Resource Analysis Course
FMS	Financial Management School
FSTD	Formal Schools Training Division
HIMARS	High Mobility Artillery Rocket System
JJAS	June, July, August, September
LVS	Logistics Vehicle System
LVSOC	Logistics Vehicle System Operators Course
M&RA	Manpower and Reserve Affairs
MCCES	Marine Corps Communication-Electronics School
MADFS	Marine Artillery Detachment, Fort Sill
MCCSSS	Marine Corps Combat Service Support School
MCT	Marine Combat Training
MDFLW	Marine Detachment, Fort Leonard Wood

MOS	Military Occupational Specialty
MOVOC	Motor Vehicle Operators Course
MTIC	Marine Transport Instruction Company
MTVR	Medium Tactical Vehicle Replacement
NAB	Naval Amphibious Base
OM	Operations Management
ONDJ	October, November, December, January
PAS	Personnel Administration School
PRASP	Permissive Recruiter Assistant Program

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I. INTRODUCTION

A. INTRODUCTION

The Marine Corps Enlisted Entry-Level Training (EELT) pipeline is a complex system responsible for transforming civilians into Marines capable of performing a myriad of tasks required to sustain the Marine Corps. This report provides a detailed process description and throughput analysis of four Military Occupational Specialty (MOS) schools, or what will be known within this report as Formal Learning Centers (FLC), within the EELT pipeline. This description and analysis is performed using process analysis techniques found within the Operations Management (OM) discipline of study. This chapter will discuss the origin of this research, the scope of the report, and the significance of seeking improvement within the EELT pipeline.

B. BACKGROUND

The EELT pipeline is a large, complex system that consists of many different processes and segments. The EELT pipeline begins with planning and forecasting processes that predict the total number of new Marines by Occupational Field that the Marine Corps must access in a year. This number of new accessions must be balanced with the number of personnel already present within the Marine Corps. Factors such as personnel retention rates, promotion rates, and congressionally mandated personnel end-strength authorizations must be carefully considered during the development of an accessions goal.

After planners develop an accessions goal, recruiters are assigned their portion of that goal to recruit into the Marine Corps. After a recruiter successfully recruits a civilian into the Marine Corps, the EELT pipeline must be prepared to receive, process, and train this Marine until he meets the qualifications necessary to join the operating forces. Each new recruit must travel through multiple nodes of the EELT pipeline prior to reporting to the operational force as a fully-qualified Marine prepared to execute the duties of his

assigned Military Occupational Specialty (MOS). First, a new accession must complete recruit training, a process that transforms a civilian into a basic Marine. Following recruit training, each Marine proceeds to one of two forms of basic infantry training. All Marines assigned the infantry MOS attend training at one of two Infantry Training Battalions where they receive their final MOS. All Marines assigned a MOS other than infantry attend training at one of Marine Combat Training (MCT) battalions. While at MCT, Marines learn skills required of a basic rifleman. After completing training at MCT, all noninfantry Marines then attend their MOS-specific training. This MOS training includes a wide spectrum of possible tracks, from a single MOS producing school to a multi-location, multi-school training track. Only after receiving his final MOS from his specific MOS track is a Marine sent to the operating forces. A process flow diagram developed by Alfonso, Younger, and Oh (2010) for a noninfantry Marine's EELT pipeline progression is shown in Figure 1.



Figure 1. Noninfantry Marine EELT Process Flow Diagram
(From Alfonso et al., 2010)

The second, third, and fourth nodes of Figure 1 represent the entire EELT pipeline. The third and fourth nodes of Figure 1, Marine Combat Training and MOS Training, all fall under the purview of Training Command within the Marine Corps command hierarchy. Although not depicted in Figure 1, the infantry MOS producing FLCs, Infantry Training Battalions East and West, also are under the command of Training Command. According to Training Command Order 5402.1, Training Command (2010) “analyzes, designs, develops, resources, implements, and evaluates standards-based individual training in order to provide combat-capable Marines and Sailors to the operating forces” (p. 1–1). Training Command is responsible for coordinating the flow

of each new accession through their portion of the EELT pipeline, a complex portion that includes 13 Formal Schools, 18 separate Marine Detachments, 5 Aviation Training Support Groups, and 16 different Marine Representatives and Marine Liaisons to major sister service training commands. Each of the Formal Schools, Detachments, and Aviation Training Support Groups is responsible for executing multiple courses.

The complexity and magnitude of Training Command's portion of the EELT pipeline and its necessary interaction with previous nodes and the operating forces prompted leadership within Training Command to seek third-party research and analysis of their system. The desired result of this analysis is to develop a model or tool that can be used to gauge the effect of individual changes within the system to the overall EELT pipeline itself. Alfonso et al. (2010) answered this request and analyzed the EELT pipeline from a macro perspective, describing the overall system, the planning inputs and processes used in the system, and recommending macro level adjustments to improve process effectiveness. This report builds on the analysis of Alfonso et al. (2010), and conducts a micro analysis of four FLCs within the MOS Training node depicted in Figure 1. While this report will not attempt to accomplish the original research goal of model development, this report will provide methodology and a template for the conduct of future research that will help refine the knowledge and understanding of the system as a whole.

C. RESEARCH SCOPE

Previous research into the Marine Corps EELT pipeline and other similar military training pipelines has focused on time lost within the system by personnel traveling through it. Specific examples of this type of research are discussed within Chapter II of this report. While lost or queuing time within the EELT pipeline is a worthy topic, the objective of this research project is to study potential structural inefficiencies and systematic planning errors that produce the misallocation of the scarce resources of FLCs. The FLCs analyzed in this report are at the end of the EELT pipeline, and often experience unintended effects of actions within previous nodes and even of actions prior

to a Marine's entry into the EELT. This research focuses on processes from the perspective of the individual FLC and the FLC's allocation of organic resources.

This report is conducted and presented using techniques and methods found within the Operations Management (OM) discipline of study. A thorough process analysis of each of the four FLCs research is presented. Metrics such as course and class capacity, course and class utilization, and student throughput are presented and analyzed. These process analyses and quantitative metrics assist in the identification and exposure of process weaknesses and structural flaws.

D. IMPORTANCE OF RESEARCH

The Marine Corps devotes a significant portion of its resources to the execution of the EELT pipeline. The EELT pipeline's annual throughput is approximately 30,000 Marines, almost 15% of its entire 202,100 person authorized end-strength (Alfonso et al., 2010, p. 3). As previously described, the EELT pipeline is an extremely complex system. Each person who travels through the EELT must complete multiple schools and execute multiple travel segments. The scheduling, coordination, and execution of each individual node are inextricably linked to the scheduling, coordination, and execution of multiple other nodes within the system. Structural and procedural inefficiencies at any node of this system negatively affect the ability of the EELT pipeline to operate smoothly, and inevitably lead to increased delays within the system, inefficient use of system resources, and increased fiscal costs. Identification of, further research into, and procedural correction of these flaws will result in decreased EELT pipeline transit times and reduced fiscal and resource expense.

E. SUMMARY

This chapter provided the background of this research report, an introduction to the EELT pipeline, the scope of this report, and this report's significance to the Marine Corps. The subsequent chapters will provide a review of relevant research on similar topics, a description of the methodology used for this report, a description of the specific FLCs used for this research, a process analysis of each FLC used for this report, and summary, conclusions, and recommendations based on the findings of this report.

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II. LITERATURE REVIEW

A. INTRODUCTION

The purpose of this chapter is to present previous relevant research that has been performed on the subject of entry-level training process improvement. This literature review has been organized into two sections: entry-level training pipeline assessments and occupational specific assessments.

B. ENTRY-LEVEL PIPELINE ASSESSMENTS

This section addresses research conducted at the macro-level of the entry-level training process. Studies within this section primarily address overall processes concerning the Marine Corps' entry-level training pipeline as a whole, initial occupational specialty assignments, and optimizations of schedules relating to recruit training and the entire system of initial Military Occupational Specialty (MOS) schools.

1. Alfonso, Younger, and Oh, 2010

Alfonso et al. (2010) perform a top-down study of the Marine Corps Enlisted Entry-Level Training (EELT) pipeline using the process analysis techniques of Operations Management. Alfonso et al. analyze the EELT pipeline, beginning at force structure and manpower planning, continuing through recruitment and initial military and basic combat training, and concluding with initial MOS training. At this last phase, Alfonso et al. analyze one MOS training school; specifically, the Marine Detachment at Fort Leonard Wood, Missouri, which provides initial occupational training for Marines with the 1341 MOS, Engineer Equipment Mechanic.

Alfonso et al. suggest five improvements to the existing EELT pipeline process. First, distribute accessions evenly throughout the year to minimize variability within arrival at each node within the EELT pipeline. Next, shift the EELT process away from the existing “push” system to a “pull” system, enabling successive nodes within the

pipeline to receive input, in this case trainees, when there is available capacity to handle them. Third, ensure throughput capacity is maximized within the October through January trimester, a time period that usually experiences a decline in throughput due to the U.S. holiday schedule. Next, pursue opportunities to consolidate functions within the EELT pipeline. Finally, Alfonso et al. suggest a continued development of EELT Information Technology systems that support the flow of trainees through the EELT pipeline to improve tracking and scheduling.

This study is a direct continuation of the research of Alfonso et al (2010). Using similar Operations Management analytical tools and techniques, this study examines four specific Formal Learning Centers within the EELT pipeline. The following studies provide insight to additional research conducted on entry level training.

2. Whaley, 2001

Whaley (2001) analyzes the unproductive time new noninfantry Marines “lost” in fiscal year 1998 between the completion of recruit training and the completion of their MOS school. This “lost” time is caused by queuing within the system waiting for successive classes to start. Based on a qualitative analysis of the process the Marine Corps uses to identify specific manpower requirements, schedule initial MOS training for that manpower, and finally recruit and access that identified requirement, Whaley proposes three improvements to that portion of the continuum. First, Whaley recommends linking the Program Plan (the recruiting goals detailed by month, gender, and enlistment program) to the actual constraints of MOS training schools’ schedules and capacity earlier in planning. Second, Whaley recommended shifting from an annual MOS training request to a weekly MOS training request, allowing greater flexibility and response to the inevitable variability of arrivals within the system. Third, Whaley recommends using existing MOS training school schedules and available seats to adjust the Program Plan during execution of the accession and training year.

From a quantitative analysis perspective, Whaley offers two integer linear programs that propose more optimum schedules for accessions and MOS school classes.

The first model minimizes wait time between Marine Combat Training and initial MOS schooling and produces an initial MOS school schedule and a Program Plan. The first model is designed for manpower and scheduling planners' use two years prior to execution. The second model is designed for use one year prior to execution and produces an updated Program Plan and a MOS school training schedule with forecasted attendance at each class. This model also minimizes overall wait time for entry-level Marines.

3. Detar, 2004

Detar (2004) analyzes the wait time experienced by noninfantry Marines between the completion of Marine Combat Training and their initial MOS training school using accession and training information for fiscal year 2001. The goal of this study is to reduce the overall wait time for noninfantry Marines. Detar reviews the process of manpower requirement identification, accession scheduling, and the scheduling of the Entry-Level Training pipeline, from recruit training through completion of initial MOS training. Similar to Whaley (2001), Detar identifies the Program Plan and MOS school schedules. Detar offers an integer linear program designed to optimize MOS school class schedules, to include seats assigned by MOS and gender. Detar generates the model using input from multiple sources within the Marine Corps manpower and training continuum: the Classification Plan, the Program Plan, individual MOS school capacity statistics such as minimum and maximum class size, minimum and maximum frequency, and earliest start time. The goal of this model is to offer a fiscal-year schedule for initial MOS training schools that minimizes wait time for entry-level Marines

4. Grant, 2000

Grant (2000) analyzes the Marine Corps officer MOS assignment process at The Basic School (TBS), the initial training attended by all Marine Corps officers following their commission. Grant reviews the policy existing in fiscal year 1999 of officer assignment of simply dividing the annual new officer MOS requirements by six and distributing those MOSs in the form of "quotas" equally among the six TBS student

training companies. Within each of these six companies, training staff members assign MOSs to officers based on their lineal standing within a one-third segmenting system, staff assessments of student ability, and student MOS preferences. Although this existing system results in an equitable MOS spread within a fiscal year's officer cohort, a major flaw in the fiscal year 1999 system's enactment is a large resulting time lost caused by an uneven distribution of starting dates for follow-on MOS training classes for officers.

Grant offers a linear optimization model that minimizes lost training time due to officers waiting for MOS training. Grant incorporates existing officer MOS school class start dates within parameters of his model, thus allowing a minimization constraint to influence the eventual distribution of officer MOS quotas among the six TBS training companies. Additionally, this model is constructed with multiple adjustable constraints that allow for manipulation of relevant variables, enabling planners and TBS staff members to weigh potential costs of less than optimal solutions. For example, by adjusting a limiting constraint, a TBS staff member could see the "cost" in training days incurred by allowing an officer uniquely qualified for a specific MOS to attain that MOS even if there was not an immediate follow-on class seat available within that MOS.

C. OCCUPATIONAL SPECIFIC ASSESSMENTS

This section addresses research specifically conducted at the occupational level within the Marine Corps and Navy. The first study analyzes the Marine Corps' Communication-Electronics School training process and the second study analyzes the Navy's aviator training process.

1. Neu, Davenport, and Smith, 2007

Neu, Davenport, and Smith (2007) analyze training processes for seven separate Marine Corps MOSs at Company B, Marine Corps Communication-Electronics School (MCCES), with the goal of reducing time spent by Marines in the Marines Awaiting Training (MAT) Platoon. These MAT Marines represent a loss in training time to the Marine Corps as a whole. Neu et al. conduct the analysis focusing on traditional "lean"

techniques found within traditional business process analysis practices, including incorporating continuous improvement, theory of constraints, Little's Law, queuing theory, and activity-based costing. Focusing on intended improvement identified by these techniques, Neu et al. test the effects of local resource changes by conducting simulations in the Process Analyzer Function in Arena, a simulation software tool. Resource changes tested include student class size minimum and maximums, number of instructors, scheduled and on-demand class starts, and lecture room availability. Additionally, Neu et al. address changes that can be implemented by the MCCES local commander without an inordinate strain on existing resources. Neu et al. demonstrate the effects of numerous changes based on the outcome of multiple simulations and, based on these outcomes, recommends numerous local changes that can be made to reduce the average time Marines spend in the MAT platoon.

2. Bostick and Booth, 2005

Bostick and Booth (2005) analyze the Navy initial training pipeline for naval aviators to reduce the amount of unproductive training time within the system. Bostick and Booth present an analysis of two models currently used by naval aviation training planners, exposing flaws and inefficiencies in both models with respect to resource allocation, that result in lost time for aviation trainees. Subsequently, Bostick and Booth offer a Decision Support System (DSS) prototype, which reduces unproductive training time within the naval aviation training system by generating better solutions to resource allocation. Bostick and Booth detail the generation of this model and offer suggestions about its potential improvement and implementation. Additionally, Bostick and Booth recommend leveling the arrival rate of new aviation trainees, although they acknowledge that this would need to be preceded by an institutional change in naval aviation culture. Bostick and Booth also recommend implementation of linkages among nodes within the naval aviation training system, which would result in the signaling of system problems experienced in one node to other nodes, such as excessive queuing or early completion of training. The implementation of these recommendations was offered to reduce overall unproductive training time within the system.

D. SUMMARY

This chapter reviewed six previous studies that analyze entry-level training and recommend models and courses of action to reduce the amount of non-value-added time or unproductive wait time experienced by trainees within training systems. Alfonso et al. (2010) provide a macro level analysis of the Marine Corps EELT pipeline. Whaley (2001) and Detar (2004) both offer integer linear programs that provide improve scheduling of accessions and courses within the Marine Corps EELT pipeline. Grant (2000) offers a linear optimization model to improve assignment of the MOSs of Marine officers at The Basic School. Neu et al. (2007) offer an optimization program to reduce student waiting time at Marine Corps Communications-Electronics School. Bostick and Booth (2005) offer a DSS to reduce wait times within the naval aviation training pipeline. The next chapter will present the methodology used by this study to analyze the subject nodes explored within the scope of this study.

III. METHODOLOGY AND DATA COLLECTION

A. INTRODUCTION

The previous chapters of this report introduced the topic of research, provided a basic background and description of the Enlisted Entry-Level Training (EELT) pipeline, and reviewed six previous research reports that inform this research. This chapter provides an overview of the methods used to conduct the analysis contained within this report. The technique of Process Analysis, a component of the Operations Management (OM) discipline of study, was used to describe and analyze the Formal Learning Centers (FLC) within this report. Basic tenets of process analysis are defined and explained within this chapter. Additionally, a description of the process used to collect the data analyzed is provided.

B. METHODOLOGY

This research approaches the EELT pipeline as a single, complex transformational system. This system is composed of multiple processes and nodes, each of which is interdependent with multiple other nodes within the overall system. To systematically and effectively study the EELT pipeline, this report uses the technique of process analysis, a major component of OM. While OM is typically used to improve processes within profit seeking businesses, the basic analysis techniques are applicable to any system seeking process improvement. **Operations Management** is defined as “the design, operation, and improvement of the systems that create and deliver the firm’s primary products and services” (Jacobs, Chase, & Aquilano, 2009, p. 7). In this definition, the firm represents the entire EELT pipeline, the products represent new Marine accessions training to achieve qualification within their assigned Military Occupational Specialty (MOS), and the services represent the physical training infrastructure and instructional processes used to train these accessions. The EELT pipeline is a transformational system because it closely matches the OM definition of a

transformational process, one that “uses resources to convert inputs into some desired output” (Jacobs et al., 2009, p. 8). For the EELT pipeline, the resources used are the existing training physical infrastructure, such as school houses, barracks, and computers, personnel such as instructors and support staff, and materials such as text books, instruction manuals, and class handouts. The major input in the EELT pipeline is the new Marine accession. The desired transformation that occurs is the transformation from a civilian into a basically qualified Marine who possesses a defined set of MOS skills necessary to join the operating forces and contribute to the accomplishment of his unit’s mission.

1. Process Analysis

Jacobs et al. (2009) define a **process** as “any part of an organization that takes inputs and transforms them into outputs that ... are of greater value to the organization than the original inputs” (p. 160). As previously noted, the purpose of the EELT pipeline is to provide to the operating forces MOS-qualified Marines who possess skills absent in their previous state as civilians. The purpose of process analysis is to systematically describe a system or a process, breaking down each separate step within the system to ensure complete comprehension of the relevant factors. These factors include things organic to the system itself, and things physically outside of the system that have influence over the system. A commonly used method to begin process analysis is the construction of a process flow diagram for the system analyzed.

a. Process Flow Diagrams

A **process flow diagram** is a graphical representation of a system, depicting tasks, resource storage or queuing areas, decision points, and flow paths. Tasks are represented as boxes, queuing areas are represented by triangles, decision points are represented by stars, and flow paths are represented by arrows. An example of a process flow chart, presented in Figure 1 in Chapter I, shows a macro process flow diagram for the EELT pipeline. New accessions enter the EELT pipeline as civilians and transit through the pipeline through the Recruit Training process, Marine Combat Training

process, and MOS Training process. After completing the MOS training process, the outputs, MOS qualified Marines, transit to the operating force, the point at which the EELT pipeline ends.

The development and analysis of a process flow diagram enables greater levels of understanding of a system or a process. It allows an observer to view the process in each of its component steps, visualize the flow of resources and inputs, and note the major decision points within a system. The basic level of understanding of a process provided by a process flow diagram is the first step in analysis of a system. This report provides process flow diagrams for each of the FLCs analyzed in this report.

b. Quantitative Measures of Analysis

After constructing a process flow diagram, the calculation of several quantitative measures can reveal different aspects of a system. Determining the **capacity** of a system, or the “amount of output that a system is capable of achieving over a specific period of time,” is useful in providing an understanding of system capabilities and limitations (Jacobs et al., 2009, p. 122). For example, assigning a process to produce 100 products when that process’ maximum capacity for the given period is 50 products is an unrealistic assignment. Additionally, assigning the same process to produce 10 products during the same time period is an underutilization of available capacity. Within the EELT pipeline, capacity is determined as the total amount of classes or student throughput possible given the current allocation of resources. Determining a system’s capacity allows further calculation of system efficiency. A measurement of a process’ **utilization** represents the “ratio of the time that a resource is actually activated relative to the time that it is available for use” (Jacobs et al., 2009, p. 162). Developing an understanding of a process’ utilization allows critical analysis of appropriate resource allocation to a process. A process is a low utilization rating produces a low percentage of the total amount of a product that this process is capable of producing. Within the EELT

pipeline, utilization can be specifically defined as the ratio of courses (or classes) actually executed relative to the amount of courses (or classes) available, within the defined capabilities of the system.

Based on understanding and analysis of a system, specific segments of a process can be identified as limiters of the system. One type of limiter is a **bottleneck**, a portion or stage of the process that restricts or slows the flow of materials or inputs. A bottleneck is typically revealed by excessive queues or material buildups within a system. In the EELT, bottlenecks typically are evident by excess delay times for students prior to a class start. Another typical sign of a bottleneck is the delivery of material to a process that consists of non-value-added time. **Value added time** signifies a portion of time during which useful work is being performed on a unit (Jacobs et al., 2009, p. 170). In the EELT pipeline, an example of value added time would consist of the time a Marine spent undergoing training at one of the recruit training regiments (RTR). While undergoing training at a RTR, a Marine is gaining positive value in skills and experience and is actively transiting the EELT pipeline. Conversely, if a Marine is placed in a holding unit to await a class seat at an FLC, this is classified as non-value-added time because the Marine is not learning any additional required skills or making any forward progress in the EELT pipeline.

2. Forecasting and Capacity Planning

By creating a detailed understanding of all the separate steps of a process and calculating quantifiable input and output measures, more complex analysis of a system is enabled. This section will present the topics of forecasting and capacity planning and show how they are applicable to the EELT pipeline.

a. Forecasting

Forecasting is a process used to predict a future value of an item or number. Organizations such as manufacturing plants use various method of forecasting to “make periodic decisions involving process selection, capacity planning ... as well as

for continual decisions about production planning, scheduling, and inventory” (Jacobs et al., 2009, p. 468). In the EELT pipeline, accurate student throughput forecasting allows the EELT pipeline’s production plants, FLCs, to generate accurate class schedules, determine appropriate instructor and equipment requirements, and allocate other required resources efficiently. Forecasting **errors**, or “the difference between the forecast values and what actually occurred” creates the potential for the misallocation of scarce resources and the waste of capacity (Jacobs et al., 2009, p. 480). Forecast errors for student throughput within the EELT pipeline generate significant inefficiency and lead to wasteful resource allocation for FLCs. Conversely, accurate student throughput forecasts allow FLCs to schedule their classes effectively, and allocate their resources to closely match the anticipated arrival rates of students.

b. Capacity Planning

Jacobs et al. (2009) categorize three different time horizons for capacity planning: long range, intermediate range, and short range (p. 122). Different types of planning must be conducted for each of these time periods, based on the available information. For many business processes, the best available information is the demand forecast for their product. In the long-range planning period, time periods in excess of 1 year, decisions pertain to the procurement or reduction of major infrastructure or personnel, organizational culture and desired business practices, and major capital reinvestment. During the intermediate-range planning period, time periods between 6 to 18 months, decisions are focused on topics such as “hiring, layoffs, new tools, minor equipment purchases, and subcontracting.” During the short-range period, a period typically less than 1 month, decisions focus on “daily and weekly scheduling ... overtime, personnel transfers, and alternative production routing” (Jacobs et al., 2009, p. 122). For each of these time periods, the tools with which an organization can respond to changes within their business environment varies. As time horizons shrink, so do the available options. The relevancy of this topic becomes apparent in analysis of an FLC’s ability to respond to significant errors in forecasted student throughput.

3. Information Technology Systems

Large, dispersed networks usually benefit from effective lateral and horizontal information exchange. For example, advance notice of the shortage of component “X” from a supplier upstream of a manufacturing facility that requires component “X” to create output “Y” benefits not only the manufacturing plant, but also the seller of output “Y” downstream of the manufacturing plant. Other such examples of the value of timely and accurate information sharing abound within complex organizations. The Internet and modern information technology (IT) systems enable almost real-time information transparency. As Simchi-Levi, Kaminski, and Simchi-Levi (2008) state, “the primary goal of IT in the supply chain is to link the point of production seamlessly with the point of delivery or purchase” (p. 415). Additional goals of efficient IT systems include the ability to collect information, open access to data by all interested parties, and effective analysis tools (pp. 414–417). The EELT pipeline, an extremely large, interdependent network operating with multiple nodes dispersed throughout the breadth of the United States, benefits from the use of IT systems. Analysis of the use of these systems will be presented within this report.

This section contained a description of the methods used to conduct the analysis presented in this report. The following section will present a description of how the data used for this analysis was collected.

C. DATA COLLECTION

The data used within this report was collected in three overlapping phases. First, an extensive literature and resource review was conducted. A review of existing research reports and professional literary products, including previous Naval Postgraduate School theses, studies created by the RAND Corporation, and business textbooks, was performed. Additionally, multiple military and government documents, such as Marine Corps and Army orders and regulations, reference publications, Department of Defense memorandums, and unit-level Standard Operating Procedures, were reviewed.

Second, phone and e-mail interviews were conducted with key leaders and staff members of organizations within the EELT pipeline. Specifically, communication was conducted with personnel within the following organizations and staff sections:

- Training Command G-3, Current Operations
- Training Command G-3, Future Operations
- Training Command G-5, Plans
- Formal Schools Training Division, Training and Education Command, Director
- Marine Corps Combat Service Support Schools (MCCSSS), Academics
- Personnel Administration School, MCCSSS, Academics
- Personnel Administration School, MCCSSS, Operations
- Personnel Administration School, MCCSSS, Entry-Level Instruction
- Financial Management School, MCCSSS, Academics
- Headquarters and Services Company, MCCSSS, Commanding Officer
- Entry Level Receiving, MCCSSS, Permanent Staff
- Marine Detachment, Fort Leonard Wood, Academics / Operations
- Marine Artillery Detachment, Fort Sill, Academics
- Marine Artillery Detachment, Fort Sill, Operations

This phase of data collection focused on developing an understanding of the actual processes and procedures used by the different nodes of the EELT pipeline. The information collected through this phase and the previous literature review phase formed the foundation of the descriptive and qualitative analysis within this report.

The third method of data collection was the use of queries within the Student Registrar portal of the Marine Corps Training Information Management System (MCTIMS). Actual course and class schedules, individual class graduation data, and

individual Course Descriptive Data documents were collected for each course analyzed in this report. Additionally, Training Input Plan documents for fiscal year 2009 (Training & Education Command, 2009a) and fiscal year 2010 (Training & Education Command, 2010b) including student throughput forecasts were collected for review. The information collected within this phase constituted the majority of the inputs for the quantitative analysis contained within this report.

D. SUMMARY

This chapter reviewed the methodology and data collection techniques used in order to conduct the research and analysis for this report. A description of relevant components of Operations Management was provided. This included definitions and descriptions of major tenets of process analysis, forecasting and capacity planning, and information technology systems. An overview of the techniques used to collect data was also provided, including literature review, telephone and e-mail interviews, and data collection from the Marine Corps Training Information Management System. The next chapter presents a description of the major processes and organizations within the enlisted entry-level training pipeline that will be analyzed in this report.

IV. ENLISTED ENTRY-LEVEL TRAINING PROCESSES

A. INTRODUCTION

In the previous chapters, this report presented a sample of relevant existing research on the Enlisted Entry-Level Training (EELT) pipeline. Additionally, it presented the methodology used to analyze data for this study and the data collection techniques used to gather that data. This chapter will first present a description of the process used to forecast and schedule student throughput at each of this study's four formal learning centers (FLC) of the EELT. Afterward, this chapter will also present a basic description of each of the four FLC's structure and student handling procedures and practices.

B. FORECASTING AND SCHEDULING

This section briefly describes how the Marine Corps formulates training requirements, how each FLC participates with the Training Input Plan (TIP) conference and its output, the information technology tools that each FLC uses for its scheduling and student tracking, and a tool used to manage student queuing time.

1. Manpower End Strength and Requirements Planning

As Alfonso et al. (2010) discuss in great depth, the Marine Corps uses a systematic process to develop its personnel end strength and accessions requirements. The Total Force Structure Division determines total manpower requirements and generates the Troop List and Authorized Strength Report (ASR). Manpower and Reserve Affairs (M&RA) uses the ASR to develop the Program Plan and the Classification Plan. The Program Plan outlines, by grouping of occupational specialties, how many accessions are required in a fiscal year. Marine Corps Recruiting Command (MCRC) uses the Program Plan to shape its recruiting goals and assignment of Program Enlisted For codes. Once actual accessions enter the EELT pipeline, M&RA uses the

Classification Plan to shape its final Military Occupational Specialty (MOS) assignment. This MOS assignment will result in a Marine's individual assignment to a specific MOS producing school at an FLC within the EELT pipeline.

2. Training Input Plan

Representatives from all four FLCs in this report attend the annual TIP conference, held in March. While at the TIP conference, each unit's representatives coordinate with their Occupational Field Sponsor and various representatives from the enlisted and officer manpower planning sections from M&RA. The Occupational Field Sponsors and M&RA staff members request course allocations from each of the FLCs. In response to those requests, the FLCs raise any potential conflicts or concerns based on their available throughput capacity. The output of the TIP conference is a projected number of students for the following fiscal year, broken down into trimesters. These trimesters are (1) February, March, April and May (FMAM); (2) June, July, August, September (JJAS); and (3) October, November, December and January (ONDJ). Additionally, this output also includes a forecasted student throughput number for each of the following 4 fiscal years, years known as "out-years."

At the completion of the TIP conference, the representatives of each FLC return to their commands and, using the forecasted student throughput numbers, develop their own course schedules for the following fiscal year. They each attempt to match forecasted student throughput with scheduled class commencement dates. Additional informational inputs to this scheduling process are minimum and maximum class size as dictated by the approved course Period Of Instruction (POI), federal holidays, and the number of available transformational resources. These resources include instructors, class materials, hardware and equipment, and instructional spaces. Once all of these FLCs have developed and approved their annual schedules, those schedules are loaded into one of two informational systems.

Personnel Administration School (PAS) and Financial Management School (FMS) both submit their schedules to their higher headquarters, Marine Corps Combat

Service Support School (MCCSSS). These schedules are then entered into the Marine Corps Training Information Management System (MCTIMS). MCTIMS will be discussed later in this chapter.

Motor Transportation Instruction Company (MTIC) and Marine Artillery Detachment, Fort Sill (MADFS), as residents of Army installations Fort Leonard Wood and Fort Sill, submit their schedules in a slightly different manner. The Army is required to track all student throughput aboard their installations, regardless of service, and uses their training information management system, the Army Training Requirements and Resources System (ATRRS), to schedule, track, and record those numbers. ATRRS is able to “push” information on its system to MCTIMS; however, MCTIMS is unable to “push” information on its system to ATRRS. As such, both MDLFW and MADFS use ATRRS as their primary scheduling tool and use MCTIMS as their primary student forecasting and tracking tool.

MTIC submits its schedule to its local higher headquarters, Marine Detachment Fort Leonard Wood (MDFLW). The staff at MDFLW provides MTIC’s schedule to authorized ATRRS, typically Army staff members at Fort Leonard Wood, who input the MTIC schedule into ATRRS. ATRRS then automatically feeds the MTIC schedule into MCTIMS, a process that takes anywhere from 12 to 24 hours. Similarly, MADFS submits its schedule directly to the Army training staff at Fort Sill who input the MADFS schedule into ATRRS. Like MDFLW’s schedule, the MADFS schedule will be pushed by ATRRS into MCTIMS. Following the schedule generation in ATRRS by both MDFLW and MADFS, both units use MCTIMS to track inbound students and to generate local class rosters. During the execution of each training class, MDLFW and MADFS take paper rosters of student populations for each class to Army training staff on their installation. These paper rosters are manually input into ATRRS, which allows the Army visibility and historical documentation on throughput at each Marine course.

3. Marine Corps Training Information Management System

The Marine Corps Training Information Management System (MCTIMS) is an Internet-based database used by the Marine Corps to schedule, record, and monitor formal training schools. MCTIMS is designed to provide accurate and up-to-date training information for both individuals and units. Specifically, as used by the four FLCs in this report, MCTIMS provides information concerning past, present and future class schedules, forecasted seat allocations for classes, by-name student rosters for individuals registered for future classes, and complete by-name student rosters for classes either currently in session or already completed. The individual class roster tool allows FLCs to track actual inbound students by name, military occupational specialty, assigned course, and other information out to an effective time horizon of approximately 2 to 3 weeks. The historical course roster tool allows FLCs to track student graduation rates and course utilization rates. Additionally, detailed academic and administration information for each course taught as part of the EELT pipeline is available within MCTIMS in the form of Course Descriptive Data Documents (CDD). The accuracy of MCTIMS is dependent on timely and accurate input by users at all stages of the EELT pipeline.

4. Permissive Recruiter Assistant Program

The Marine Corps uses a tool called Permissive Recruiter Assistant Program (PRASP) to offer FLCs within the EELT pipeline an option when student arrivals do not closely match course scheduling (MCO 1130.62B, 1998). If an FLC identifies a Marine with an extended wait or queuing period anywhere along the EELT pipeline, that Marine may be granted PRASP. A Marine granted PRASP will be assigned to a recruiting station close to his home of record and will assist the local recruiters as a recruiter's assistant. PRASP is a form of permissive temporary active duty, which means that no travel, billeting, or per diem allowances are given to a Marine granted PRASP.

C. STRUCTURE

This section provides a description and process analysis diagram for each of the four FLCs in this report. Additionally, it provides a description and process analysis diagram for Entry Level Receiving, an administrative unit at Marine Corps Combat Service Support Schools that provides inputs to two of the four FLCs in this report.

1. Entry-Level Receiving

Entry-Level Receiving (ELR) is a unit within Headquarters and Services Company, Marine Corps Combat Service Support School (MCCSSS) at Camp Johnson, North Carolina. It is responsible for receiving and providing administrative care for all entry-level students inbound to any of the four MCCSSS EELT pipeline schools, including PAS and FMS. ELR receives entry-level Marines directly after their graduation from Marine Combat Training (MCT) battalion. The day prior to an entry-level Marine's arrival to ELR, the staff of ELR receives a by-name roster directly from that Marine's MCT, either East or West. This roster is ELR's first advance notice of inbound Marines, either by individual name or total quantity.

Upon checking in, an entry-level Marine undergoes in-processing procedures and receives temporary billeting. Based upon MCCSSS-designated personnel needs, an entry-level student could be assigned non-instructional, temporary duties for a period up to 3 weeks. These temporary duties include staff section augmentation within the operations and communications sections, funeral detail, Director Camp Affairs detail, Camp Guard, and ELR staff augmentation. In total, there are 91 fixed billets that must be filled by entry-level students. An ELR staff member assigns entry-level Marines to fill these billets based on the entry-level Marine's assigned school. Entry-level reservist Marines are never assigned to a temporary duty billet because of their limited activation time available. This process is shown in Figure 2.

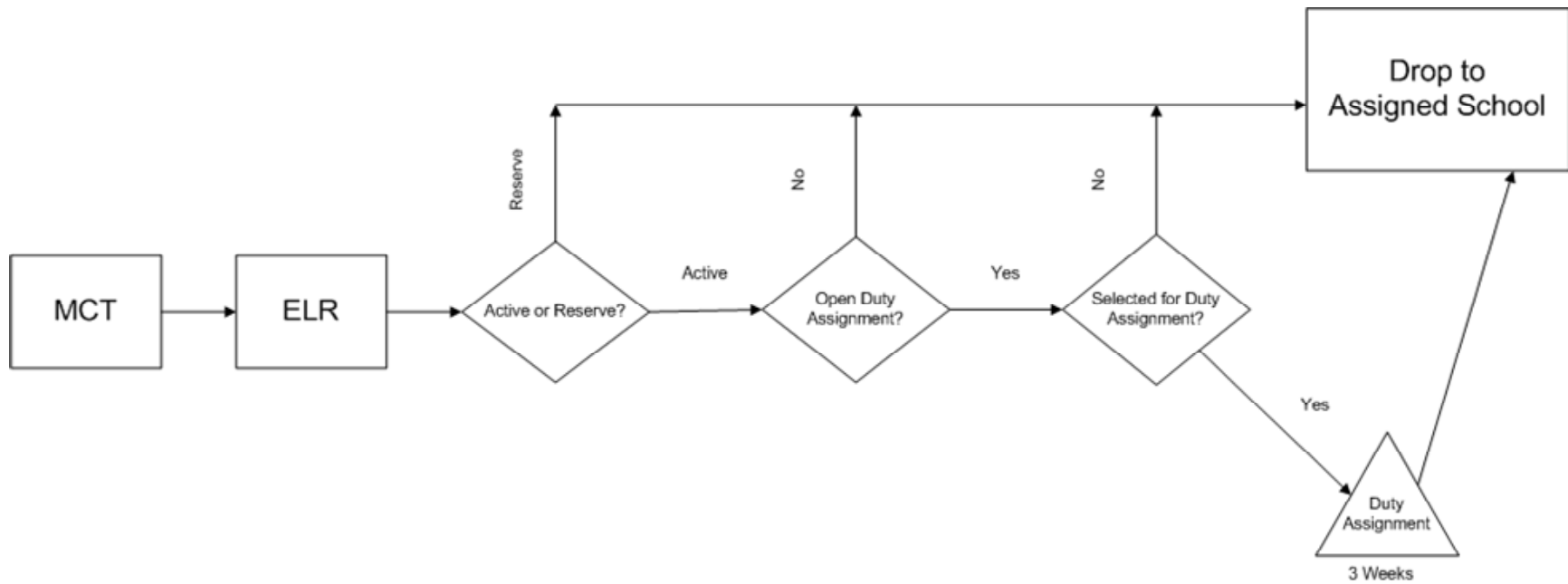


Figure 2. Entry-Level Receiving Process Flow Diagram

Any entry-level Marines not selected for temporary additional duties execute the ELR training schedule. During this training schedule, entry-level students receive MCCSSS-directed classes such as command briefs from the MCCSSS Commanding Officer and Sergeant Major, substance abuse classes from the MCCSSS Substance Abuse Counseling Officer, spiritual guidance from the MCCSSS Chaplain, and Family Advocacy classes from the Family Advocacy representative. These classes are typically held over a 3-day period. Following the completion of the ELR training schedule, all entry-level Marines not assigned to temporary additional duties are dropped to their receiving schools. This drop is typically performed on the first Friday after a student's arrival to ELR.

2. Personnel Administration School

PAS is one of four entry-level training units resident at MCCSSS in Camp Johnson, North Carolina. PAS conducts one enlisted entry-level training course, the Administrative Specialist Course (ASC), as well as other intermediate- and career-level courses.¹ For Marines attending ASC, this represents a single track, single sequence MOS training track. While attending ASC, entry-level Marines learn a multitude of unit and personnel administrative skills, such as formatting naval correspondence, awards and discipline processing, and the maintenance of unit databases. The ASC is 37 training days long (Administrative Specialist Course, 2011, p I-1).

PAS receives their pool of entry-level students from ELR. PAS relies on ELR for notification of the number of ASC students that PAS will receive on any given drop day. Depending on the ASC class schedule, newly arrived Marines will either immediately start their course of instruction or will be placed in a temporary PAS queuing unit. If a Marine is placed within the PAS queuing unit, he is prioritized for the next available school seat on a "first-in, first-out" basis. The only exception to this priority is reservists,

¹ Prior to 01 October 2010, PAS conducted two entry-level administrative courses, the Administrative Clerk Course (Training & Education Command, 2009b) and the Personnel Clerk Course (Training & Education Command, 2009a). Those two courses were consolidated into the Administrative Specialist Course on 01 October 2010.

who have the top priority for class enrollment. PAS does not employ PRASP for Marines within their queuing unit, with the exception of during the annual Christmas holiday period. Upon completion of the ASC, entry-level Marines are sent directly to the operating forces for their first duty assignment. This process is shown in Figure 3.

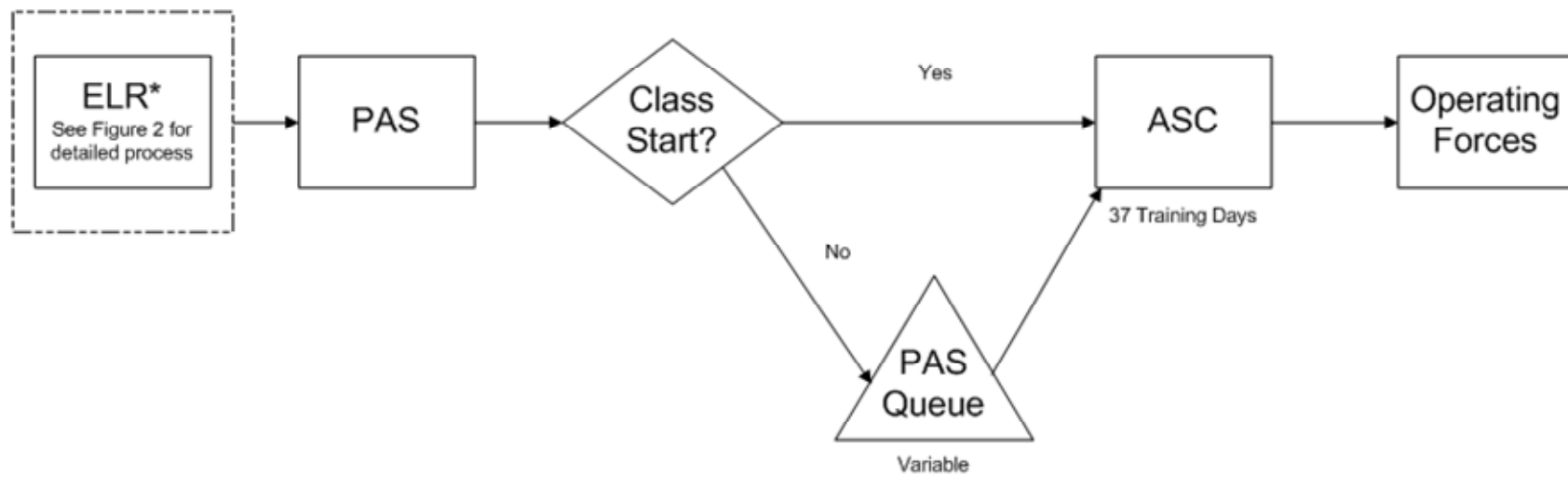


Figure 3. Personnel Administration School Process Flow Diagram

3. Financial Management School

FMS is another of the four entry-level training units resident at MCCSSS at Camp Johnson, North Carolina. FMS conducts two enlisted entry-level training courses, the Basic Finance Technician Course (BFTC) and the Financial Management Resource Analysis Course (FMRAC), as well as other intermediate and career-level courses. Entry-level Marines will attend only one of these courses, depending on their assigned MOS. This represents two separate single track, single sequence MOS training tracks.

Marines attending BFTC learn basic military pay and travel processing skills, including the use of finance publications, Internet-based unit diary systems, and how to process management reports. The BFTC is 43 training days in length and, upon graduation, Marines are awarded the MOS of 3432 (Basic Finance Technician Course, 2011, p. I-1).

Marines attending FMRAC learn basic financial management accounting techniques and fund control procedures. The FMRAC is 27 training days in length and, upon graduation, Marines are awarded the MOS of 3451 (Financial Management Resource Analysis Course, 2011, p. I-1).

FMS receives their pool of entry-level students from ELR. FMS actively tracks projected inbound students on the MCTIMS system and through communication with ELR. Depending on the appropriate course start date, newly arrived BFTC and FMRAC students will either immediately start their course upon arrival at FMS or will be placed within FMS's Marines Awaiting Training (MAT) platoon. Marines unable to immediately start a class are placed within the same MAT platoon regardless of eventual MOS. Once assigned to the MAT platoon, Marines are prioritized to attend class on a "first-in, first-out" basis. The only exception to this priority is reservists, who have the top priority for class enrollment. FMS uses the PRASP system in order to reduce the amount of time their entry-level Marines spend in MAT. Upon completion of their assigned school, entry-level Marines are sent directly to the operating forces. This process is shown in Figure 4.

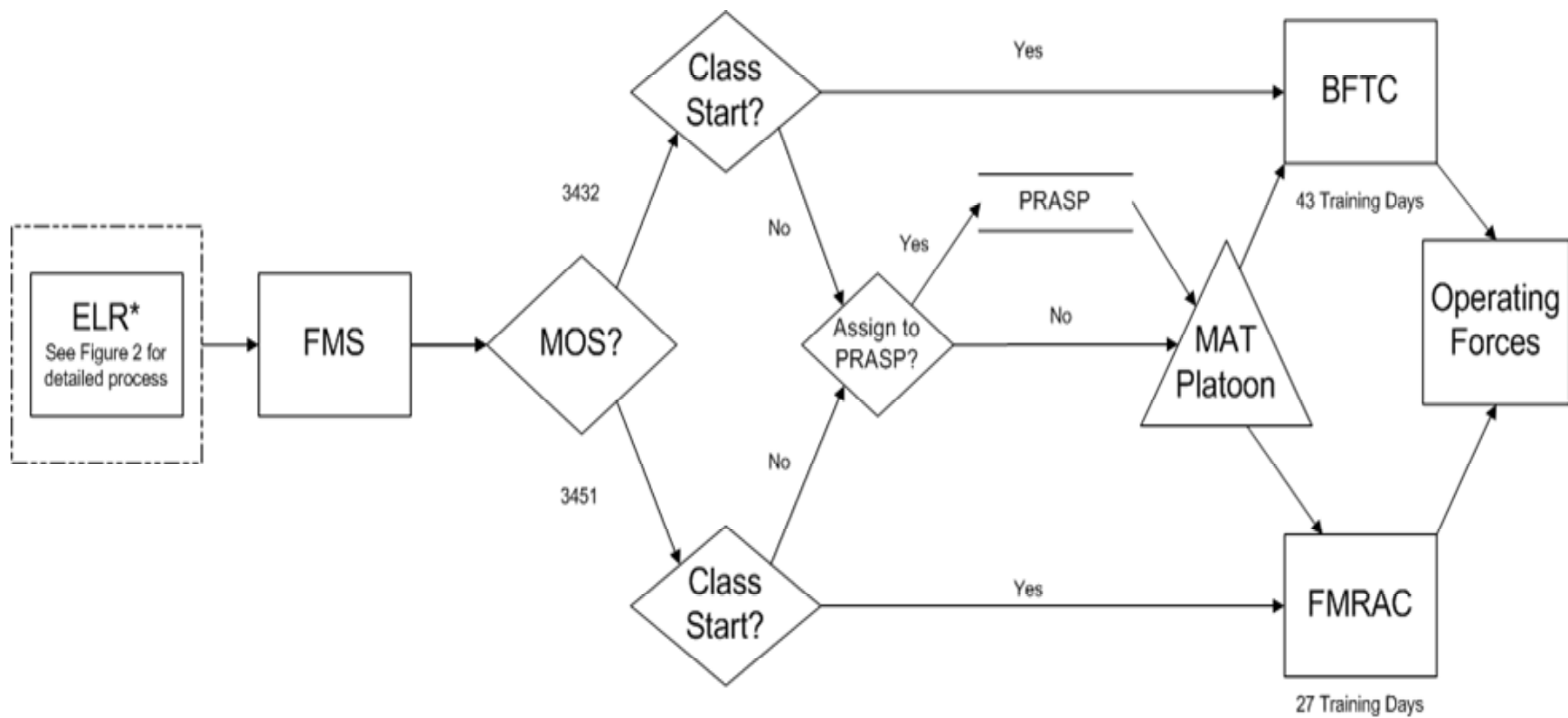


Figure 4. Financial Management School Process Flow Diagram

4. Motor Transportation Instructor Company

MTIC is one of five schools resident at the Marine Detachment, Fort Leonard Wood, Missouri. MTIC conducts two enlisted entry-level training courses, the Motor Vehicle Operators Course (MOVOC) and the Logistics Vehicle System Operators Course (LVSOC), along with a host of other intermediate- and career-level courses. All entry-level Marines assigned to MTIC attend the MOVOC. At the completion of MOVOC, a predesignated number of Marines who meet MTIC established criteria will attend LVSOC to receive additional training. This represents a single track, multi sequence MOS training track.

Marines attending MOVOC learn to operate the High Mobility, Multi-Wheeled Vehicle (HMMWV) and the Medium Tactical Vehicle Replacement (MTVR). Additionally, they learn numerous other military vehicle operating skills, such as towing procedures, driving while wearing night vision goggles, and cargo loading. The MOVOC is 30 training days in length and Marines are awarded the MOS of 3531 upon graduation (Motor Vehicle Operators Course 1.1, 2011, p. I-1).

During the execution of MOVOC, MTIC instructors evaluate students to determine which students have the best potential to succeed at LVSOC. Those Marines selected to attend LVSOC will commence that course immediately following MOVOC. Marine attending LVSOC will learn to operate the Logistics Vehicle System (LVS) and additional tasks associated with its operation. The LVSOC is 23 training days in length and Marine are awarded the additional MOS of 3533 upon graduation (Logistics Vehicle System Operators Course, 2011, p. I-1).

Marines check into the Marine Detachment, Fort Leonard Wood, straight from one of the two MCTs. Upon arrival to the Marine Detachment, entry-level Marines will be dropped to their appropriate school if there is a class with an open slot starting immediately. If there is not a class immediately convening, or if there is not an available slot in that convening class, a Marine will be sent to the Marine Detachment's MAT Platoon. The Marine Detachment consolidates all entry-level Marines awaiting a class

pickup, regardless of which school the Marine may be attending, at this Marine Detachment unit. Once within the MAT platoon, a Marine will be prioritized on a “first-in, first-out” basis. The only exception to this priority is reservists, who have the top priority for class enrollment. The Marine Detachment will use PRASP on a rare, case-by-case basis, typically for Marines who have demonstrated a high level of maturity and are forecasted to have an exceptionally long wait period until their class start date. Upon completion of MOVOC and LVSOC, if assigned, Marines will report directly to the operating forces for their first tour of duty. This process is shown in Figure 5.

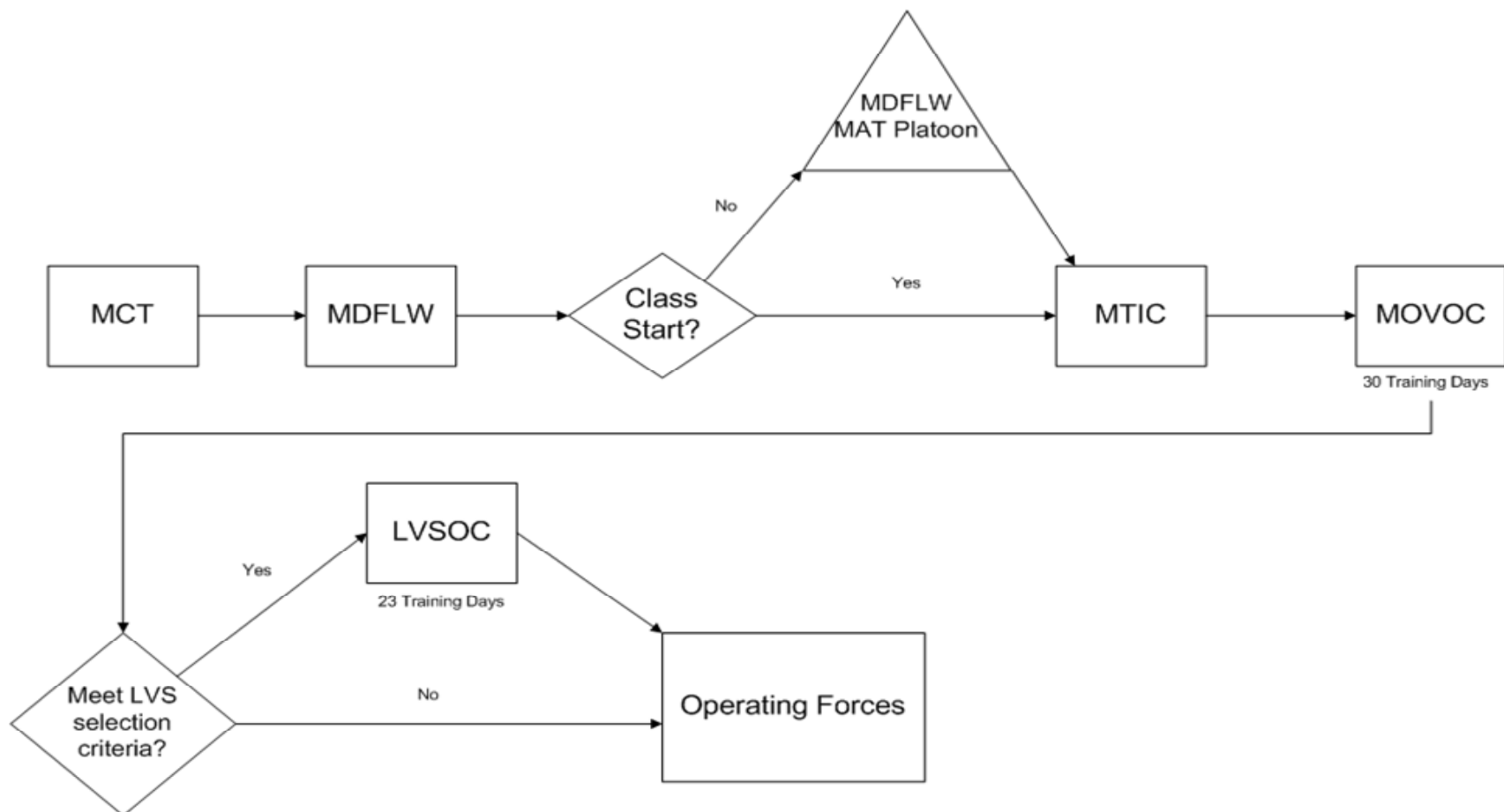


Figure 5. Motor Transport Instructor Company Process Flow Diagram

5. Marine Artillery Detachment, Fort Sill

The Marine Artillery Detachment, Fort Sill (MADFS) is an independent Marine detachment located aboard Fort Sill, Oklahoma. The MADFS conducts seven enlisted entry-level artillery related courses in addition to numerous other intermediate- and career-level courses. The seven enlisted entry level courses are the Cannon Crewman Course, High Mobility Artillery Rocket System (HIMARS) Operators Course, Firefinder Radar Operator Course, Fire Controlman Course, Sensor Supportman Course, Scout Observers Course and Artillery Electronic Maintenance Course. Six of these courses are independent, stand-alone courses specific to different MOSs. The seventh, the HIMARS Operators Course, is a possible follow-on course to the Cannon Crewman Course. In addition to the courses taught at MADFS, two other nodes represent sequences in this track. First, all graduates of the Scout Observer Course must attend a follow-on course, Fire Support Man Course, conducted at Naval Amphibious Base (NAB), Coronado, California, prior to their completion of the EELT pipeline and receipt of their MOS. Second, prior to arriving at MADFS, all Marines assigned to Artillery Electronic Maintenance Course have graduated from Basic Electronics Course held at Marine Corps Communication-Electronics School (MCCES) at Twentynine Palms, California. For these last two groups of Marine students and the Marines assigned to the HIMARS course, these paths represent single-track, multi sequence MOS training tracks. For each of the other groups of Marine students, their paths are representative of single track, single sequence MOS training tracks.

Marines attending Cannon Crewman Course learn how to be a member of a howitzer section, learning skills such as operation and maintenance of the M198 and M777 howitzers and field firing techniques. The Cannon Crewman Course is 25 training days in length and, upon graduation, Marines are awarded the MOS of 0811 (Marine Corps Cannon Crewman, 2011, p. I-1).

Marines attending the HIMARS Operators Course learn how to be a member of a HIMARS section, learning skills such as maintenance and operation of the HIMARS

M142 launcher and field firing techniques. The HIMARS Operators Course is 13 training days in length and graduates receive the MOS of 0814 (Marine Corps High Mobility Artillery Rocket System (HIMARS) Operators Course, 2011, p. I-1).

Marines attending the Firefinder Radar Course learn how to operate the multiple variants of the AN/TPQ-36 and AN/TPQ-37 radar systems and other related tasks. The Firefinder Radar Course is 40 training days in length and graduates are awarded the MOS of 0842 (Mitchell, 2003, p. 2-1).

Marines attending the Fire Controlman Course learn the skills required to function as a member of an artillery fire direction center, including manual and automated gunnery techniques. The Fire Controlman Course is 28 training days in length. After graduation, Marines are awarded the 0844 MOS (Field Artillery Fire Controlman (USMC), 2011, p I-1).

Marines attending the Sensor Supportman Course learn techniques of artillery survey, meteorology, acoustics, and command and control systems. The Sensor Supportman Course is 69 training days in length and, upon graduation, Marines receive the MOS of 0846 (Marine Artillery Sensor Supportman Course, 2011, p. I-1).

Marines attending the Scout Observers Course learn skills required to execute observed fires procedures. Marines are instructed in the use of communications equipment, fire support control measures, and manual and automated fire control procedures. Scout Observers Course is 28 training days in length. Upon graduation from Scout Observers Course, students are required to attend Fire Support Man Course held at NAB, Coronado, California (Marine Artillery Scout Observer Course, 2011, p. I-1). Upon graduation of Fire Support Man Course at NAB Coronado, Marines are awarded the MOS 0861.

Marines attending Artillery Electronic Maintenance Course learn the operation and maintenance of multiple pieces of electronic artillery equipment, including the AN/TPQ-46 Counter Mortar Radar, the AN/TMQ-41 Meteorological Measuring Station, and the M-94 Muzzle Velocity System. All students attending the Artillery Electronic

Maintenance Course have previously graduated the Basic Electrician's Course held at MCCES (Training & Education Command, 2010a, p. 3). The Artillery Electronic Maintenance Course is 135 training days in length. Graduates of the course receive the 2887 MOS (Marine Artillery Electronic Maintenance Course, 2009, p. I-1).

MADFS receives enlisted entry-level artillery Marines from both of the two MCTs. Additionally, MADFS receives ground electronic maintenance Marines from MCCES. Depending on specific class start dates and available class openings, these Marines will either commence their classes or join the MADFS's Marine Training Battery. The Marine Training Battery is a queuing unit that holds Marines until they are able to begin formal instruction in a scheduled class. Once in the Marine Training Battery, Marines are prioritized on a "first-in, first-out" basis. The only exception to this priority is reservists, who have the top priority for class enrollment. MADFS does not normally use PRASP to reduce a Marine's time in the Marine Training Battery, with the exception of during the annual Christmas holiday period. Graduates of Firefinder Radar Operator Course, Fire Controlman Course, Sensor Supportman Course, and Artillery Electronic Maintenance Course all receive their MOS and are sent directly to the operational forces. Graduates of the Cannon Crewman Course all receive the MOS of 0811 and are screened by their next duty assignment. Those 0811s that are assigned for duty with 2nd Battalion, 11th Regiment Marines (2/11) and 5th Battalion, 14th Marine Regiment (5/14), the two Marine artillery regiments with HIMARS, are sent to the HIMARS Operators Course and then to the operating forces. Those 0811s not assigned to 2/11 or 5/14 are sent directly to the operating forces. Graduates of the Scout Observer Course are sent to NAB, Coronado, to complete their entry-level training and receive their MOS of 0861. This process is shown in Figure 6.

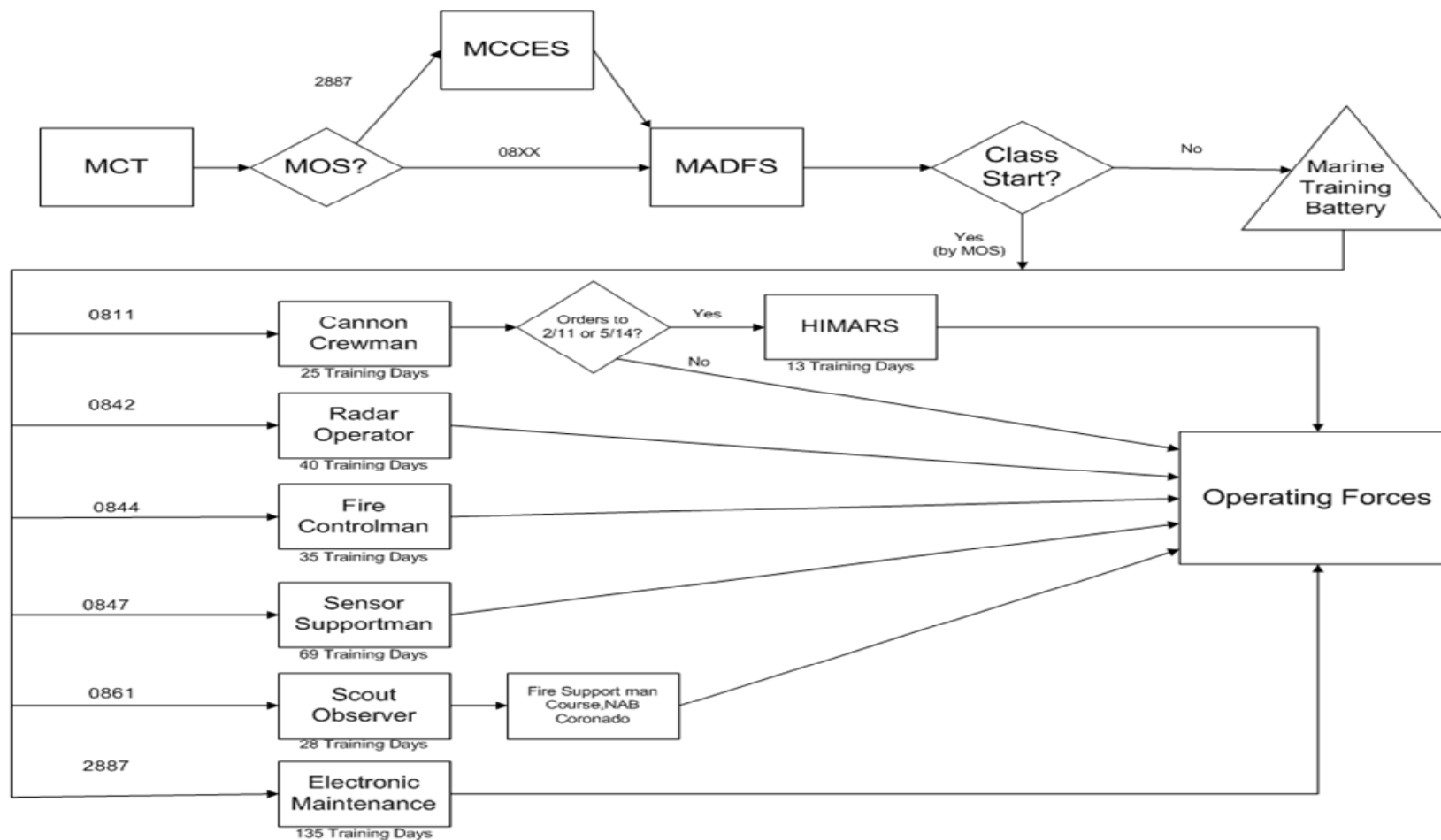


Figure 6. Marine Artillery Detachment, Fort Sill Process Flow Diagram

D. SUMMARY

In this chapter, this report provided a qualitative description of the processes used to forecast and schedule student throughput at each of this study's four FLCs. A basic outline of the Marine Corps' Manpower End Strength and Requirement planning was provided. Tools used to assist this planning and the planning of throughput for the EELT pipeline, such as the TIP and MCTIMS, were presented. The purposes and administration of PRASP were introduced. The process that Entry-Level Receiving uses to process student input to Personnel Administration School and Financial Management School was described. Finally, descriptions and process flow diagrams for Personnel Administration School, Financial Management School, Motor Transport Instructor Company, and Marine Artillery Detachment, Fort Sill were provided. This chapter's purpose was to provide a basic understanding of the processes used to identify and allocate the inputs for the EELT, and how four selected FLCs plan and execute their student throughput. In the next chapter, this report will present a quantitative description and analysis of each FLC's capacity, utilization, and throughput.

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V. FORMAL LEARNING CENTER PROCESS ANALYSIS AND OBSERVATIONS

A. INTRODUCTION

Chapter IV provided a description of the processes that each Formal Learning Center (FLC) in this report participates in to forecast, schedule, and execute its student throughput. This chapter will provide quantitative and qualitative analysis of those processes and of the execution of each FLC's student throughput. Each section will provide insight into the nature of the calculations or analysis techniques used and the results of that analysis.

B. QUANTITATIVE ANALYSIS

This section provides quantitative analysis of each FLC's student throughput, course capacity and course and class utilization rates. Additionally, analysis of predicted and actual student throughput rates, both annually and trimester, are provided.

1. Course Capacity and Utilization Rates

This report defines a "course" as an Enlisted Entry-Level Training (EELT) unit of curriculum that results in the achievement of a Military Occupational Specialty (MOS) for a graduate. The term "course" is intentionally differentiated from the word "class". A "class" is defined as the execution of one iteration of the curriculum that constitutes a course. For example, Financial Management School (FMS) conducts the Financial Management Resource Analysis Course (FMRAC) to qualify Marines with the Military Occupational Specialty of 3451. During fiscal year 2010, FMS executed eight classes of the FMRAC course.

As discussed in Chapter IV, each FLC analyzed in this report conducts one or more EELT courses within a year. This report uses information from a variety of sources as inputs for the qualitative calculations presented for each of those courses. One source

of information is each course's Course Descriptive Data (CDD). A CDD is a document that contains information specific to each course, including a description of the course itself, a breakdown of manpower and equipment resources required to execute the course, class minimum and maximum capacities, and class frequencies. Another source of data used for the calculations within this section is the Marine Corps Training Information System (MCTIMS) (Training & Education Command, 2007)². Introduced in Chapter IV, MCTIMS provides authorized users the ability to generate reports based on user queries. For this study, reports of individual course schedules and individual class rosters were generated using the MCTIMS Student Registrar portal. The results of these reports are incorporated into the analysis detailed within this section.

² MCTIMS was established as a Program of Record in 2007. Prior to its formal establishment, MCTIMS existed as the Training & Education Information Management System (TIMS). MCTIMS access can be gained by submitting a user authorization request form found at <http://www.hqmc.usmc.mil/PP&O/PS/psl/trainingHome.asp>.

a. Maximum Annual Capacity

Maximum annual capacity for a course is determined by multiplying the total number of classes that a course can conduct by the maximum number of students each class can train. This information is found within the CDD maintained for each course. Additionally, the total number of students actually trained for each course during fiscal year 2010 was obtained from MCTIMS. The difference between the maximum annual capacity and the actual throughput is presented as an error term. This difference is also presented in as a percentage of the capacity to provide a relative value of the error term. These calculations are shown in Table 1.

- $\text{Total Number of Classes} * \text{Maximum Number of Student per Class} = \text{Maximum Annual Capacity}$
- $\text{Actual Annual Student Throughput} - \text{Maximum Annual Capacity} = \text{Error}$
- $(\text{Actual Throughput} / \text{Maximum Annual Capacity}) * 100 = \text{Percentage Error}$

Functional Learning Center	Course	Maximum Number of Classes per year	Maximum number of students per class	Maximum Annual Capacity	Fiscal Year 2010 Actual Annual Throughput	Error (Actual - Capacity)	Percentage Error (Actual / Capacity)
PAS	ASC*	46	30	1380	1176	-204	85.22%
FMS	FMRAC	5	35	175	65	-110	37.14%
	BFTC	9	25	225	152	-73	67.56%
MADFS	Cannon	8	96	768	638	-130	83.07%
	HIMARS	4	8	32	70	38	218.75%
	Radar	7	12	84	101	17	120.24%
	Fire Controlman	11	25	275	182	-93	66.18%
	Sensor Supportman**	4	24	96	34	-62	35.42%
	Scout Observer	7	30	210	208	-2	99.05%
	Electronics Maint.	3	8	24	18	-6	75.00%
MDFLW	MOVOC	46	60	2760	1979	-781	71.70%
	LVSOC	21	33	693	631	-62	91.05%

*ASC inputs for fiscal year 2010 was obtained from the Administrative Clerk Course and the Personnel Clerk Course. The resources of these courses were combined at the beginning of fiscal year 2011 to create ASC. This calculation provides a general idea of the capacity and throughput for ASC for fiscal year 2010.

**Two pilot classes of the Sensor Supportman Course were executed in fiscal year 2010. The calculations for fiscal year 2010 represent those two classes only.

Table 1. Annual Capacity, Throughput, Error and Percentage Error for Fiscal Year 2010

The first two columns of Table 1 represent the FLC and the Course Title. The third column presents the maximum number of classes per year a course can execute, according to its CDD. The fourth column represents the maximum number of students that an individual class can train. The fifth column is the product of the third and fourth column and represents the maximum annual capacity of a course, given the constraints placed upon it by its CDD. The sixth column presents the actual number of students that graduated from each course in fiscal year 2010. The seventh column is the difference between the fifth and sixth column and represents the difference between the maximum annual capacity of a course and the throughput that course actually executed in fiscal year 2010. The last, or eighth, column is the quotient obtained by dividing the actual throughput (column 6) by the maximum capacity (column 5). This shows the difference between the actual throughput and the maximum throughput in percentage terms. This percentage is a potentially more useful result as it provides the relative value of the difference that the actual number in column 7 may not show.

The maximum annual capacity calculations presented are theoretical calculations, based on assumptions that both the maximum number of classes possible is executed and that the maximum number of students is assigned to each class. In Table 1, since the Marine Artillery Detachment, Fort Sill, is capable of executing eight classes of the Marine Corps Cannon Crewman Course with a maximum of 96 students in each class, the maximum annual capacity of the Cannon Crewman course is 768 students. This number is relevant because it shows the maximum number of students each FLC could train in each course in a fiscal year using existing resources and instructional parameters directed by the course CDDs.

In execution, the Cannon Crewman course trained 638 students in fiscal year 2010. This total of 638 students is 130 students less than the Cannon Crewman Course's maximum capacity of 768 students a year. The error term, the difference between the actual throughput and the maximum capacity displayed in column 7, is 130 students for this course. While that number does contain significance, a more relevant number is the error percentage, or the relative value of the number of students trained in

comparison to the maximum capacity of the course. In the case of the Cannon Crewman, this error percentage is 83.07%. This means that of in fiscal year 2010, the Cannon Crewman Course trained 83.07% of the actual number of students that it had the capacity to train.

Further individual course analysis based on the calculation contained in Table 1 is not conducted because maximizing course capacity is not the primary mission of FLCs. Rather, actual manpower requirements designated by institutions other than the FLCs influence the actual scheduling, throughput, and capacity utilization. Annual manpower requirements drive assigned throughput, not course capacity. Single-year capacity calculations are relevant; however, historical trends of capacity utilization are more useful in identifying whether an FLC is maintaining either an excess or a shortage of resources. For example, courses such as the HIMARS Operators Course or the Artillery Firefinder Radar Course show high utilization rates of 218.75% and 120.24%, respectively. If these courses maintain utilization rates significantly over 100% over several consecutive fiscal years, planners might reasonably identify the need to review their CDDs, forecasting methods, and potentially increase the resources to these courses to more effectively handle this capacity demand. Such a historical review and analysis is beyond the scope of this study.

b. Course Utilization

Utilization rates are useful indicators of a process' operational efficiency. Utilization rates reveal how much of process' capacity is being used during the time period analyzed. A low utilization rate indicates that a process has excess capacity and implies idleness for some of its assigned resources. For the processes analyzed in this report, low course or class utilization rate indicate potential points of underutilized resources, such as instructor personnel, equipment, and facilities. A high utilization rate indicates a process that operates at close to its maximum capacity. Processes with high utilization rates typically experience queuing (wait times) for their inputs and are bottlenecks in production. In this report, high course or class utilization rates indicate

potential points of increase student waiting times. Economists note that “the best operating point [utilization rate] is near 70% of the maximum capacity” (Jacobs et al., 2009, p. 133).

Course utilization is determined by dividing the actual number of classes a FLC is capable of running by the actual number of classes a FLC executed. This number is multiplied by 100 to express the result in percentage terms. The number of classes executed was obtained from MCTIMS and the number of potential classes was obtained from the course CDDs. Course utilization calculations for fiscal year 2010 are shown in Table 2.

- $(\text{Total Number of Classes Executed} / \text{Maximum Number of Potential Classes}) * 100 = \text{Course Utilization Percentage}$

Functional Learning Center	Course	Number of Classes Executed	Number of Potential Classes	Course Utilization
PAS	ASC*	43	50	86.00%
FMS	FMRAC	4	5	80.00%
	BFTC	8	9	88.89%
MADFS	Cannon	8	9	88.89%
	HIMARS	4	4	100.00%
	Radar	6	7	85.71%
	Fire Controlman	10	11	90.91%
	Sensor Supportman**	2	2	100.00%
	Scout Observer	7	7	100.00%
	Electronics Maint.	3	3	100.00%
MDFLW	MOVOC	37	46	80.43%
	LVSOC	21	21	100.00%

*Course Utilization for ASC was calculated by combining the number of classes executed and the number of potential classes for the Administrative Clerk Course and the Personnel Clerk Course. The resources of these courses were combined at the beginning of fiscal year 2011 to create ASC. This calculation provides a general idea of the efficiency of the resources used for ASC.

**There were two pilot classes of the Sensor Supportman Course in fiscal year 2010.

Table 2. Course Utilization, Fiscal Year 2010

The first two columns of Table 2 represent the FLC and course title. The third column displays the total number of classes executed in fiscal year 2010. The fourth column displays the total number of classes that a course has the capacity to execute in a fiscal year according to its CDD. The fifth column presents the course utilization, which is the result of dividing the number of classes actually executed by the maximum number of classes a course can run. This number presents a percentage of maximum capacity in terms of number of classes.

The course utilization figures in Table 2 are useful in showing how efficient each FLC was in executing the total number of classes that it is capable of executing according to the applicable CDD. Five of the courses were run at maximum utilization, the High Mobility Artillery Rocket System (HIMARS) Operators Course, the Artillery Sensor Supportman Course, the Artillery Scout Observer Course, the Artillery Electronics Maintenance Course and the Logistics Vehicle System Operators Course. It should be noted that during fiscal year 2010, the Artillery Sensor Supportman Course was a pilot course executed to validate the curriculum. The two classes represented were specifically scheduled and executed by MADFS. The remaining seven courses were executed at a utilization rate between 80% and 91%.

Overall, the relatively high course utilization rates indicate that each FLC was generally efficient in execution of the appropriate number of overall classes, based on their existing capacity to execute classes and the expected throughput. The next section presents calculations depicting the efficiency in each class's overall utilization.

2. Class Utilization Rates

As defined in the previous section, a "class" is a single iteration of the curriculum that constitutes a course. This section uses student graduation data within MCTIMS and course capacity data contained within CDDs to determine individual class utilization rates, average class utilization rates for fiscal year 2010, average class utilization rates for each trimester of fiscal year 2010 individually, and average class utilization rates for the first trimester of fiscal year 2011. Each individual class' utilization rate was found by

dividing the total number of graduates in each class by the class capacity of that class. Each time period's class utilization rate was found by averaging the total class utilization rates for each course within the specified time period. The class convening date within MCTIMS was used to delineate into which trimester specific class throughput was included. There are weaknesses associated with this method of trimester throughput classification as explained in the subsequent analysis sections; however, this method was determined to provide the most utility to this study. Average class utilization rates for each noted time period are shown in Table 3.

- $(\text{Total Number of Student Graduates per Class} / \text{Maximum Capacity of Class}) * 100 = \text{Individual Class Utilization Percentage}$
- $\text{Sum of Each Course's Individual Class Utilization Percentages Per Specified Time Period} / \text{Number of Total Classes Per Specified Time Period} = \text{Average Class Utilization Rate Per Specified Time Period}$

Functional Learning Center	Course	Average Fiscal Year 2010 Class Utilization Rate	ONDJ Fiscal Year 2010 Utilization Rate	FMAM Fiscal Year 2010 Utilization Rate	JJAS Fiscal Year 2010 Utilization Rate	ONDJ Fiscal Year 2011 Utilization Rate
PAS	ASC*	91.16%	90.88%	90.42%	93.33%	95.71%
FMS	FMRAC	46.43%	40.00%	60.00%	42.86%	48.57%
	BFTC	76.00%	84.00%	64.00%	76.00%	66.00%
MADFS	Cannon	83.07%	105.90%	80.56%	52.60%	68.40%
	HIMARS	109.38%	112.50%	109.38%	106.25%	37.50%
	Radar**	140.28%	120.83%	162.50%	137.50%	108.33%
	Fire Controlman	72.80%	82.00%	72.00%	61.33%	70.00%
	Sensor Supportman***	70.83%	62.50%	79.17%	N/A	104.17%
	Scout Observer	99.05%	100.00%	103.33%	91.67%	73.33%
	Electronics Maint.	75.00%	87.50%	68.75%	N/A	75.00%
MDFLW	MOVOC	89.14%	91.00%	97.75%	72.67%	88.19%
	LVSOC	91.05%	110.61%	98.48%	65.80%	74.55%
Overall Average****		83.31%	90.44%	84.47%	73.61%	69.73%

*ASC inputs for fiscal year 2010 was obtained from the Administrative Clerk Course and the Personnel Clerk Course. The resources of these courses were combined at the beginning of fiscal year 2011 to create ASC. This calculation provides a general idea of the efficiency of the resources used for ASC.

** Radar Course has enacted significant curriculum changes. Its CDD is outdated, therefore, the results shown are of negligible value.

***Two pilot classes of the Sensor Supportman Course were executed in fiscal year 2010. The calculations for fiscal year 2010 represent those two classes only.

****Firefinder Radar Course and Artillery Sensor Supportman Course were excluded from the Overall Average calculations.

Table 3. Class Utilization Rates, Fiscal Year 2010 and ONDJ Trimester, Fiscal Year 2011

The first two columns of Table 3 represent the FLC and course title. The third column displays the annual utilization rate for each course for fiscal year 2010. This was calculated by finding the sum average of class utilization rates for a course in the year. The fourth, fifth, sixth and seventh columns each represent trimester's class utilization rate for the specified time period. This was calculated by finding the sum average of each trimester's individual class utilization rates. The last row in Table 3 presents the sum average of the courses' utilization rates for the column's specified time period.

The class utilization rates presented in Table 3 offer a different perspective than the course utilization rates presented in the previous section. While the course utilization rates offer insight into the efficiency of number of classes offered within a year, the class utilization rates offer insight into how well each one of those classes was filled with students. The distinction between the two different rates is meaningful. For example, a course could offer very few classes based on its class offering capacity, resulting in a low course utilization rate, but could fill each of the classes that it does offer to capacity, resulting in a high class utilization rate. On the other hand, a course could offer its maximum total number of classes possible within a year, resulting in a high course utilization rate, but could train well below the number of students possible in each individual class, resulting in a low class utilization rate.

a. Annual Utilization Rates

Each course's annual class utilization rate is displayed in Column 3 of Table 3. Several course utilization rates indicate that on an annual basis, class capacity is maintained at desirable level. The Administrative Specialist Course, Basic Financial Technician Course, Cannon Crewman Course, Artillery Fire Controlman Course, Artillery Electronic Maintenance Course, Motor Vehicle Operator Course (MOVOC), and Logistics Vehicle System Operators Course (LVSOC) all exhibit utilization rates that fall within a desirable range. This indicates that the resources allocated to these courses are being used efficiently.

The FMRAC exhibits an annual utilization rate of 46.43%. This rate is considered low. To illustrate, the maximum class size for the Financial Management Resource Analysis Course (FMRAC) is 35, as published by the FMRAC CDD. With a utilization rate of 46.43%, the average student population of each class was 17 (number rounded up from 16.25 for ease of illustration), 18 students fewer than class capacity. There were four classes of the FMRAC conducted in fiscal year 2010. As a result, a total of 76 potential class seats went unfilled. Resources allocated to these 72 slots were potentially unused and subject to idleness or waste.

The HIMARS Operators Course exhibits an annual utilization rate of 109.38%. This rate is considered to exceed capacity or over-utilization. To illustrate, the maximum class size for the HIMARS Operator Course is 16, as promulgated by the HIMARS Operators Course CDD. Each of the four HIMARS Operators Course classes executed in fiscal year 2010 exceeded its published capacity, by an average of 1.5 students. This implies that either the resources allocated to the course were overtaxed or that additional resources were reallocated from other assigned processes. In either case, the potential for less than optimum outcomes exists, either evidenced by over-utilization of training resources such as instructors or equipment or dilution of training for class participants.

Similar to the HIMARS Operators Course, the Artillery Scout Observer Course exhibits a high class utilization rate, 99.05%. Upon close examination of the available data, of the seven classes of the Artillery Scout Observer Course executed in fiscal year 2010, four of them were at the CDD maximum published capacity of 30 students, two exceed the maximum capacity, and one was below the maximum capacity. The same potential for less than optimal outcomes discussed with the HIMARS Operators Course exists for the Artillery Scout Observer Course.

The utilization rates for the Artillery Firefinder Radar Operator (Radar Operator) and Artillery Sensor Supportman Courses presented in Table 3 are of minimal value for analysis of a quantitative nature. The data contain in the Radar Operator CDD has not maintained pace with changes implemented at MADFS. This lack of accurate

caused by the outdated CDD for the Radar Operator Course indicates a need for CDD revision. Revisions to the CDD that capture the updated class parameters will allow the MADSF staff to gauge their process effectiveness. Additionally, the annual utilization calculations for the Artillery Sensor Supportman Course are based solely on two pilot classes executed in fiscal year 2010, and as such, do not reveal relevant information for an established process.

b. Trimester Utilization Rates

An examination of each course's trimester utilization rates in Table 3 allows a comparison among the three fiscal year 2010 trimesters and the annual fiscal year 2010 utilization rate experienced by a course. Additionally, the inclusion of the first trimester of fiscal year 2011 allows observations on the consistency across multiple time periods and comparison to the same trimester in two successive fiscal years. Utilization rates that vary widely across different observed periods of time are indicators of potential sources of friction in a system. In processes such as this, planners experience difficulties in allocating resources efficiently due to uncertain future system requirements.

As Table 3 shows, courses exhibit varying patterns of class utilization throughout the trimesters. The Administrative Specialist Course, HIMARS Operators Course, Artillery Fire Controlman Course, Artillery Scout Observer Course, and Artillery Electronics Maintenance Course all exhibit relatively steady levels of utilization. This implies that each of these courses experience relatively constant flow of students and that staff of each of these courses are able maintain a steady usage of their resources. This does not indicate that the resources are necessarily optimally utilized. For example, while steady, the utilization rate for the Artillery Fire Controlman is within the lower range of desirability, implying that there is a consistent degree of idle capacity within its system. Conversely, the HIMARS Operators Course utilization rate is consistently high, which implies that there is a consistent degree of over-utilization within its system. The previous two examples show how the consistency of the utilization is best matched with other relevant data points to inform the most complete analysis of a process.

Unlike the courses discussed in the previous paragraph, FMRAC, Basic Finance Technician Course (BFTC), Cannon Crewman Course, Motor Vehicle Operators Course (MOVOC), and Logistics Vehicle System Operator Course (LVSOC) all exhibit class utilization rates that vary significantly throughout the fiscal year. The class utilization rates for these courses vary from 20 percentage points to 53 percentage points among the three trimesters of fiscal year 2010. This degree of variation is a potential source of difficulty for course planners to mitigate, with efficient resource allocation across this variability difficult to manage. Because courses require adequate resources to efficiently handle periods of high class utilization, there exists a distinct possibility that these same resources are idle during periods of low course utilization. For example, during the October, November, December, January (ONDJ) trimester, LVSOC experienced a class utilization rate of 110.61%. In the June, July, August, September (JJAS) trimester, LVSOC experienced a class utilization rate of 65.80%. This represents a 44.81 percentage point shift in class utilization. The level of resources required to handle a 110.61% trimester is significantly different than the level of resources required to handle a 65.80% trimester. This variation within one fiscal year presents a challenge and potential friction point for those responsible for the efficient allocation of resources and scheduling.

The final calculation performed in Table 3 is an average of each time period's class utilization rates. Due to data inconsistencies noted previously within this report, the class utilization rates for the Artillery Firefinder Radar Course and Artillery Sensor Supportman Course were not included in this calculation. Each course included in this calculation was given equal weight in this average, regardless of the total number of classes held or the total student throughput of each class. This calculation reveals one salient point that has been noted in many other studies, such as Alfonso et al. (2010) and Whaley (2001), and confirms anecdotal information provided by each FLC interviewed for this report. On average, class capacity rates are highest during the ONDJ trimester and decline steadily throughout the rest of the fiscal year. This phenomenon is shown by the class utilization rates found for this study for fiscal year 2010: 90.44% for ONDJ, 84.47 for February, March, April, May, and 73.61% for JJAS. This effect is caused by

the entry of a large bubble of new accessions into the EELT in the summer months. This bubble slowly makes its way through the EELT pipeline and arrives at the FLCs referenced in this study during the ONDJ trimester. This bubble has been the source of debate among Marine Corps planners and leaders and further debate is beyond the scope of this report.

3. Predicted and Actual Throughput

In order to mitigate the adverse effects of wide variation in class utilization rates, the Marine Corps attempts to accurately forecast student throughput for FLCs. This forecast, known as the Training Input Plan (TIP), was introduced and described in Chapter IV. An accurate forecast of student throughput allows FLCs to schedule and allocate resources more efficiently. For example, if the staff of LVSOC knows of an expected period of low class utilization, it can potentially allow excess instructor staff to perform other missions and schedule required maintenance for excess vehicles. Although these actions do not mitigate the fact that the course has excess capacity, it does allow some resources to be usefully employed elsewhere. In this section, calculations comparing forecasted student throughput and actual student throughput are presented. These calculations, presented by FLC, are expressed in totals for fiscal year 2010, each trimester of fiscal year 2010, and the first trimester of fiscal year 2011. The differences, or error, between the forecasted number and actual number are presented in whole numbers and as percentages of the forecasted number. These error terms will present a picture of the accuracy of the TIP forecasts for fiscal year 2010.

Throughput calculations were performed using data obtained from MCTIMS and the fiscal years 2010 and 2011 TIPs for Marine Courses and Army Courses. Throughput is defined as the number of individual student graduates for any given course. As in the previous section, students were classified into a year group and a trimester group based on the date of their class convening. This information was all obtained within MCTIMS. Forecast data for each course was obtained from the fiscal years 2010 and 2011 TIPs for Marine Courses and Army Courses. The forecasted throughput numbers for courses held

at PAS and FMS were found with the TIP for Marine Courses. The forecasted throughput numbers for courses held a MTIC and MADFS were found in the TIP for Army courses. As previously mentioned in Chapter IV, the TIP documents provide throughput forecasts in terms of total annual forecasted numbers and forecasted numbers by trimester. Each is relevant for analysis.

To calculate the forecast error term, the number of students a course actually trained is subtracted from the number of students a course was forecasted to train. The result of this calculation is the absolute difference between the forecasted throughput and the throughput actually experience by a course. For example, forecast error of -5 signifies that the actual student throughput of a course is 5 fewer than the forecasted student throughput. The sign of the error term is significant. A negative forecast error term indicates that a course trained fewer than the amount of students that the TIP forecast. A positive forecast error term indicates that a course trained more than the amount of students that the TIP forecast.

- Forecasted Student Throughput – Actual Student Throughput = Forecast Error

This absolute forecast error is useful; however, the absolute error term provides no relative value, in terms of magnitude, of the figure to the observer. For example, a forecast error of 5 students is significantly different between a course that has an annual throughput of 20 students and a course that has an annual throughput of 1,000 students. Therefore, to provide the relative value of the error term, a further calculation of throughput percentage error is provided. This calculation is obtained by dividing the actual throughput by the forecasted throughput and multiplying the result by 100. The result provides a percentage error term that reveals the relative amount of student throughput in terms of the forecasted student throughput. For example, a course with a percentage error term of 75% can be said to have actually trained 75% of the number of students forecasted to be trained by the TIP, or 25% fewer than the originally forecasted amount. Likewise, a course with a percentage error term of 125% can be said to have actually trained 125% of the number of student forecasted to be trained by the TIP, or

25% more than the originally forecasted amount. A forecast percentage error of 100% signifies that a course trained exactly the same number of students that the TIP predicted that it would, in the noted time period.

- $$\frac{(\text{Actual Student Throughput} / \text{Forecasted Student Throughput}) * 100}{\text{Forecast Percentage Error}}$$

This report only analyzes possible effects of forecasting errors on the use of FLC resources and quality of instruction. While the error term reveals a potential absolute shortage or overage of qualified personnel of a specific MOS, this shortage or overage may actually be absorbed in the overall MOS manning by factors beyond the scope of this report, such as unexpected levels of retention or attrition in a particular MOS, lateral moves into and out of an MOS not captured in the EELT pipeline, and other unknown factors. While this potential outcome is worthy of study and may provide insight in cases of significant throughput forecast error, it is beyond the scope of this report.

a. Throughput Comparison, Fiscal Year 2010

Throughput data and calculations for fiscal year 2010 are shown in Table 4.

Functional Learning Center	Course	Fiscal Year 2010 Actual Annual Throughput	Fiscal Year 2010 Forecasted Annual Throughput	Fiscal Year 2010 Error (Actual - Forecasted)	Fiscal Year 2010 Percentage Error (Actual / Forecasted)
PAS	ASC*	1176	1212	-36	97.03%
FMS	FMRAC	65	93	-28	69.89%
	BFTC	152	197	-45	77.16%
MADFS	Cannon	638	609	29	104.76%
	HIMARS	70	56	14	125.00%
	Radar	101	105	-4	96.19%
	Fire Controlman	182	196	-14	92.86%
	Sensor Supportman**	34	N/A	N/A	N/A
	Scout Observer	208	215	-7	96.74%
	Electronics Maint.	18	22	-4	81.82%
MDFLW	MOVOC	1979	2566	-587	77.12%
	LVSOC	631	661	-30	95.46%
Overall Average					92.19%

*ASC inputs for fiscal year 2010 was obtained from the Administrative Clerk Course and the Personnel Clerk Course. The resources of these courses were combined at the beginning of fiscal year 2011 to create ASC. This calculation provides a general idea of the efficiency of the resources used for ASC.

**Two pilot classes of the Sensor Supportman Course were executed in fiscal year 2010. There was no forecasted TIP data for this Occupational Specialty.

Table 4. Throughput Comparison, Fiscal Year 2010

The first two columns of Table 4 display the FLC and course title. The third column displays the actual throughput of each course for fiscal year 2010, as reported in the MCTIMS Student Registrar portal. The fourth column displays the forecasted throughput, contained within the fiscal year 2010 TIP. The fifth column presents the forecast error, the difference between the actual throughput and the forecasted throughput. The number in the fifth column represents the difference, in whole numbers, between the actual and forecasted student throughput. The sixth column of Table 4 presents the forecast error percentage, calculated by dividing the actual throughput by the forecasted throughput. This forecast error percentage displays the error as a relative value between what a course actually trained and what the course was forecasted to train. A forecast percentage error of 100% signifies that a course trained the exact number of students that the TIP forecasted. A score below 100% signifies that a course trained fewer than the TIP forecasted and a score above 100% signifies that a course trained more than the TIP forecasted. At the bottom of the sixth column, the sum average of all courses' forecast error percentage is presented.

As discussed in the previous section, the absolute error figure is relevant; however, the more useful calculation is the percentage error. As shown in Table 4, many courses achieved an actual throughput relatively close to their forecasted throughput, as evidenced by percentage errors in the low to high 90s such as ASC, Artillery Firefinder Radar Operator Course, Artillery Fire Controlman Course, Artillery Scout Observers Course, and Logistics Vehicle System. These high percentages indicate that the forecasting processes used to predict throughput for these courses and the preceding EELT pipeline nodes succeeded in providing the forecasted number of students to the courses for the annual period. Courses experiencing this range of percentage error require less resource manipulation and flexibility because they receive the expected amount of student throughput.

Conversely, forecast percentage errors either significantly above 100% or in the low 80s and below reveal courses that experienced student throughput significantly different than the forecasted amount. For example, the HIMARS Operators Course

experienced a forecast percentage error of 125.00%. This indicates that the HIMARS Operator Course trained 25% more students, an absolute number of 14, more students than the TIP originally forecast. It is possible that this increase placed a strain on the resources allocated to the HIMARS Operators Course or the quality of instruction received by the students. At a minimum, planners for the HIMARS Operators Course had to adjust their scheduling and resource allocation to meet the increased demand. At the other end of the spectrum, FMRAC, BFTC, and MOVOC all experienced forecast percentage errors of 69.89%, 77.16% and 77.12%. These low percentages reveal that these courses trained significantly fewer students than the original forecasted amounts. Resources initially allocated toward the training of these additional students were potentially idle or subject to waste due to the inaccurate forecast.

b. Throughput Comparison, ONDJ, FMAM, JJAS of Fiscal 2010 and ONDJ of Fiscal 2011

Tables 5, 6, 7, and 8 present actual throughput, forecasted throughput, forecast error and forecast error percentages for each of trimester of fiscal year 2010 and the first trimester of 2011. Tables 5, 6, 7, and 8 were all calculated in the same manner as was Table 4. The first two columns of each table display the FLC and course title. The third column displays the actual throughput of each course for the specified trimester, as reported in the MCTIMS Student Registrar portal. The fourth column displays the forecasted trimester throughput, contained within the Fiscal Year 2010 TIP (Training & Education Command, 2009a) and Fiscal Year 2011 TIP (Training & Education Command, 2010b). The fifth column presents the forecast error, the difference between the actual throughput and the forecasted throughput for the specified trimester. The number in the fifth column represents the difference, in whole numbers, between the actual and forecasted student throughput for the specified trimester. The sixth column of Tables 5, 6, 7, and 8 presents the forecast error percentage, calculated by dividing the actual throughput by the forecasted throughput. This forecast error percentage displays the error as a relative value between what a course actually trained and what the course was forecasted to train. A forecast percentage error of 100% signifies that a course

trained the exact number of students that the TIP forecasted for the specified trimester. A score below 100% signifies that a course trained fewer than the TIP forecasted and a score above 100% signifies that a course trained more than the TIP forecasted. At the bottom of the sixth column of Tables 5, 6, 7, and 8, the sum average of all courses' forecast error percentage for the specified time period is presented.

Functional Learning Center	Course	Fiscal Year 2010 ONDJ Trimester Actual Throughput	Fiscal Year 2010 ONDJ Trimester Forecasted Throughput	Fiscal Year 2010 ONDJ Trimester Error (Actual - Forecasted))	Fiscal Year 2010 ONDJ Trimester Percentage Error (Actual / Forecasted)
PAS	ASC*	546	572	-26	95.45%
FMS	FMRAC	14	39	-25	35.90%
	BFTC	63	89	-26	70.79%
MADFS	Cannon	305	287	18	106.27%
	HIMARS	18	22	-4	81.82%
	Radar	29	50	-21	58.00%
	Fire Controlman	82	91	-9	90.11%
	Sensor Supportman**	15	N/A	N/A	N/A
	Scout Observer	60	98	-38	61.22%
	Electronics Maint.	7	10	-3	70.00%
MDFLW	MOVOC	835	1222	-387	68.33%
	LVSOC	219	314	-95	69.75%
Overall Average					73.42%

*ASC inputs for fiscal year 2010 was obtained from the Administrative Clerk Course and the Personnel Clerk Course. The resources of these courses were combined at the beginning of fiscal year 2011 to create ASC. This calculation provides a general idea of the efficiency of the resources used for ASC.

**Two pilot classes of the Sensor Supportman Course were executed in fiscal year 2010. There was no forecasted TIP data for this Occupational Specialty.

Table 5. Throughput Comparison, ONDJ Trimester, Fiscal Year 2010

As Table 5 shows, the overall forecast percentage error for the ONDJ trimester of fiscal year 2010 is 73.42%, the percentage error most distant from 100% from among the three trimesters of fiscal year 2010. This signifies that the forecast error was greatest for this trimester for fiscal year 2010. Notable percentage errors within this trimester are FMRAC with a 35.90% error, Artillery Firefinder Radar Course with a 58.00%, and Artillery Scout Observer with a 61.22%. These courses experienced actual throughput significantly lower than that predicted by the TIP. These low rates imply that resources initially allocated and scheduled for use within this trimester were severely under-utilized for these courses.

Functional Learning Center	Course	Fiscal Year 2010 FMAM Trimester Actual Throughput	Fiscal Year 2010 FMAM Trimester Forecasted Throughput	Fiscal Year 2010 FMAM Trimester Error (Actual - Forecasted)	Fiscal Year 2010 FMAM Trimester Percentage Error (Actual / Forecasted)
PAS	ASC*	406	377	29	107.69%
FMS	FMRAC	21	32	-11	65.63%
	BFTC	32	64	-32	50.00%
MADFS	Cannon	232	192	40	120.83%
	HIMARS	35	17	18	205.88%
	Radar	39	33	6	118.18%
	Fire Controlman	54	62	-8	87.10%
	Sensor Supportman**	19	N/A	N/A	N/A
	Scout Observer	93	69	24	134.78%
	Electronics Maint.	11	7	4	157.14%
MDFLW	MOVOC	748	800	-52	93.50%
	LVSOC	260	207	53	125.60%
Overall Average					115.12%

*ASC inputs for fiscal year 2010 was obtained from the Administrative Clerk Course and the Personnel Clerk Course. The resources of these courses were combined at the beginning of fiscal year 2011 to create ASC. This calculation provides a general idea of the efficiency of the resources used for ASC.

**Two pilot classes of the Sensor Supportman Course were executed in fiscal year 2010. There was no forecasted TIP data for this Occupational Specialty.

Table 6. Throughput Comparison, FMAM Trimester, Fiscal Year 2010

The overall forecast percentage error for the FMAM trimester of fiscal year 2010 is 115.12%, as shown in Table 6. This means that there were 15.12% more students trained this trimester than the TIP forecasted. Unlike the ONDJ trimester averages shown in Table 5, many of the courses in this trimesters exhibited forecast percentage errors significantly over 100%. The Cannon Crewman Course exhibited a 120.83%, the HIMARS Operator Course exhibited a 205.88%, the Artillery Scout Observer exhibited 134.78%, Artillery Electronics Maintenance Course exhibited 157.14% and the Logistics Vehicle System Operators Course exhibited a 125.60%. These deviations from the forecast imply that resources initially allocated to these courses this trimester were significantly overtaxed or that these courses required additional resources not originally planned. A more explanatory analysis of the Artillery Electronics Maintenance Course is provided in the analysis of the following trimester.

Conversely, both PAS courses exhibited forecast error percentages significantly lower than 100%. FMRAC and BFTC showed error percentages of 65.63% and 50.00% respectively. As mentioned with previous similarly low error percentages, these two courses likely experienced idle resources this time period.

Functional Learning Center	Course	Fiscal Year 2010 JJAS Trimester Actual Throughput	Fiscal Year 2010 JJAS Trimester Forecasted Throughput	Fiscal Year 2010 JJAS Trimester Error (Actual - Forecasted)	Fiscal Year 2010 JJAS Trimester Percentage Error (Actual / Forecasted)
PAS	ASC*	224	263	-39	85.17%
FMS	FMRAC	30	22	8	136.36%
	BFTC	57	44	13	129.55%
MADFS	Cannon	101	130	-29	77.69%
	HIMARS	17	17	0	100.00%
	Radar	33	22	11	150.00%
	Fire Controlman	46	43	3	106.98%
	Sensor Supportman**	0	N/A	N/A	N/A
	Scout Observer	55	48	7	114.58%
	Electronics Maint.	0	5	-5	0.00%
MDFLW	MOVOC	396	544	-148	72.79%
	LVSOC	152	140	12	108.57%
Overall Average					98.34%

*ASC inputs for fiscal year 2010 was obtained from the Administrative Clerk Course and the Personnel Clerk Course. The resources of these courses were combined at the beginning of fiscal year 2011 to create ASC. This calculation provides a general idea of the efficiency of the resources used for ASC.

**Two pilot classes of the Sensor Supportman Course were executed in fiscal year 2010. There was no forecasted TIP data for this Occupational Specialty.

Table 7. Throughput Comparison, JJAS Trimester, Fiscal Year 2010

Similar to the previous trimester, the JJAS trimester exhibited numerous courses with forecast percentage errors significantly above 100%. This is shown in Table 7. FMRAC exhibited 136.36%, BFTC exhibited 129.55%, Artillery Firefinder Radar Course exhibited 150.00%, and Artillery Scout Observer Course exhibited 114.58%. Additionally, multiple courses exhibited forecast percentage errors significantly lower than 100%, such as the Cannon Crewman Course with 77.69% error and MOVOC with 72.79% error. The effects of these errors remain the same on effective resource allocation as discussed for previous trimesters.

Another significant result is the Artillery Electronic Maintenance Course, which results in a 0.00%. An explanation of this result is reflective of a potential weakness of the classification of trimesters used for this analysis and of the TIP forecasting methodology. The fiscal year 2010 TIP forecast five students for this trimester, JJAS, of the Artillery Electronic Maintenance Course. During fiscal year 2010, MADFS executed three classes of the Artillery Electronic Maintenance Course, the first convening in the ONDJ trimester and two convening in the FMAM trimester. Of the two courses convening in the FMAM trimester, the first convened on 22 March with six students and the second convened on 24 May with five students. This second course convened seven days prior to the JJAS trimester. As reported in Chapter IV, the Artillery Electronic Maintenance Course is 135 training days long, and as such, both of these classes extended into the JJAS trimester. However, due to the construct of the quantitative analysis technique used for this study, that of classifying classes by the convening date, this phenomenon skews the results of this particular course, and potentially others. Additional potential issues brought about by this phenomenon will be discussed in Section D of this chapter.

Functional Learning Center	Course	Fiscal Year 2011 ONDJ Trimester Actual Throughput	Fiscal Year 2011 ONDJ Trimester Forecasted Throughput	Fiscal Year 2011 ONDJ Trimester Error (Actual - Forecasted)	Fiscal Year 2011 ONDJ Trimester Percentage Error (Actual / Forecasted)
PAS	ASC*	402	554	-152	72.56%
FMS	FMRAC	17	30	-13	56.67%
	BFTC	66	72	-6	91.67%
MADFS	Cannon	197	272	-75	72.43%
	HIMARS	6	20	-14	30.00%
	Radar	26	43	-17	60.47%
	Fire Controlman	70	79	-9	88.61%
	Sensor Supportman	25	35	-10	71.43%
	Scout Observer	44	92	-48	47.83%
	Electronics Maint.	6	8	-2	75.00%
MDFLW	MOVOC	683	1025	-342	66.63%
	LVSOC	123	185	-62	66.49%
Overall Average					66.65%

*ASC Forecast inputs for ONDJ Trimester was obtained from the Administrative Clerk Course and the Personnel Clerk Course TIP forecasts. The Fiscal Year 2011 TIP was published prior to the establishment of the ASC. This calculation provides a rough estimate of the accuracy of the TIP forecast for ASC.

Table 8. Throughput Comparison, ONDJ Trimester, Fiscal Year 2011

The results of calculations performed in Table 8 reveal that all forecast percentage errors for the ONDJ trimester of fiscal year 2011 fall below 100%. This indicates that the actual throughput each course experienced was below the throughput forecasted by the TIP. In fact, the sum average of all course forecast error percentages was 66.65%. This is very similar to the results for the same trimester of the previous fiscal year. Subtraction of the two reveal a slight 6.77 percentage point difference between the two trimesters' overall average forecast percentage error. This indicates that the overall pattern may be consistent; however, further research is required to either affirm or deny this hypothesis. Regardless, for this particular trimester, all of the courses trained fewer students than the number originally forecasted in the TIP.

c. Average Trimester Forecast Error Percentage Comparison

Table 9 consolidates the forecast error percentage for each of these times periods into a single table. The first two columns of Table 9 contain the FLC and course title. Columns 3, 4, 5, 6, and 7 each present the forecast error percentage for each specified time period, previously displayed in Tables 4, 5, 6, 7, and 8. The method used to generate these calculations has been provided earlier within this chapter. Additionally, the bottom row displays the sum average of all the courses' forecast error percentages within that time period. The presentation of Table 9 allows analysis of overall trends that may not be evident by using the annual or trimester forecast error percentages in isolation.

Functional Learning Center	Course	Fiscal Year 2010 Percentage Error (Actual / Forecasted)	Fiscal Year 2010 ONDJ Trimester Percentage Error (Actual / Forecasted)	Fiscal Year 2010 FMAM Trimester Percentage Error (Actual / Forecasted)	Fiscal Year 2010 JJAS Trimester Percentage Error (Actual / Forecasted)	Fiscal Year 2011 ONDJ Trimester Percentage Error (Actual / Forecasted)
PAS	ASC*	97.03%	95.45%	107.69%	85.17%	72.56%
FMS	FMRAC	69.89%	35.90%	65.63%	136.36%	56.67%
	BFTC	77.16%	70.79%	50.00%	129.55%	91.67%
MADFS	Cannon	104.76%	106.27%	120.83%	77.69%	72.43%
	HIMARS	125.00%	81.82%	205.88%	100.00%	30.00%
	Radar	96.19%	58.00%	118.18%	150.00%	60.47%
	Fire Controlman	92.86%	90.11%	87.10%	106.98%	88.61%
	Sensor Supportman**	N/A	N/A	N/A	N/A	71.43%
	Scout Observer	96.74%	61.22%	134.78%	114.58%	47.83%
	Electronics Maint.	81.82%	70.00%	157.14%	0.00%	75.00%
MDFLW	MOVOC	77.12%	68.33%	93.50%	72.79%	66.63%
	LVSOC	95.46%	69.75%	125.60%	108.57%	66.49%
Average		92.19%	73.42%	115.12%	98.34%	66.65%

*ASC inputs for fiscal year 2010 was obtained from the Administrative Clerk Course and the Personnel Clerk Course. The resources of these courses were combined at the beginning of fiscal year 2011 to create ASC. This calculation provides a general idea of the efficiency of the resources used for ASC.

**Two pilot classes of the Sensor Supportman Course were executed in fiscal year 2010. There was no forecasted TIP data for this Occupational Specialty.

Table 9. Combined Forecast Percentage Error

A comparison of the annual forecast error percentage and each trimester's forecast error percentage reveals that increased layers of calculations aid more informed analysis and are likely much more beneficial to stake holders. For example, as shown in Table 9, the annual forecast error percentage for Artillery Firefinder Radar Operator Course is 96.19%. This percentage reveals that this course experienced annual throughput very close to the throughput forecast by the fiscal year 2010 TIP. However, an examination of each trimester's average forecast error percentage reveals that for each trimester, there was significant forecast error. The trimesters experienced throughput differentials of 42.00%, 18.18% and 50.00%. This variation is significant and exposes the potential for misuse of resources. This provides a much different picture than the course's annual forecast percentage error of 96.19%.

Table 9 reveals that many courses exhibit a similar pattern of annual forecast error percentages relatively close to 100%, but trimester averages that exhibit significant variability and deviation from the forecast. Other examples of courses like this include the Artillery Scout Observer Course, Artillery Electronics Maintenance Course, and the Logistics Vehicle System Operators Course. Observers viewing only the annual forecast error percentage could be misled into thinking that the throughput forecast provided by the TIP was accurate and that courses experienced little variation from that forecast.

The section provided a quantitative analysis of course capacity, utilization rates, and a comparison of forecast and actual student throughput. The next section provides a qualitative description and analysis of potential friction points uncovered within this section of the EELT pipeline.

C. QUALITATIVE ANALYSIS

This section provides a qualitative analysis of aspects of different aspects of the EELT pipeline researched. Topics include the potential for assignment to temporary additional duties at Entry Level Receiving at Marine Corps Combat Service Support

Schools, the Training Input Plan, the MCIMS and ATRRS information technology systems, and Course Descriptive Data documents.

1. Entry Level Receiving Assignment Process

A description and process flow diagram of Entry Level Receiving (ELR) at Camp Johnson, North Carolina was provided in Chapter IV. ELR provides input to both PAS and FMS. Additionally, ELR simultaneously provides input to two other EELT pipeline FLCs outside the scope of this study. Marine Corps Combat Service Support Schools (MCCSS), the higher headquarters for ELR, PAS, and FMS, has established an internal additional temporary duty requirement. This additional duty requirement consists of a ninety-one person work detail, assignment to which lasts three calendar weeks or a potential total of 15 training days. If students are assigned to this temporary duty, they perform tasks not associated with any MOS instruction and are delayed 3 weeks in their progress through the EELT pipeline. This entire period is classified as “non-value added time,” signifying that no value, in terms of progress toward MOS training, is accrued by the student.

ELR typically receives a pool of EELT pipeline students each week, each assigned to one of the four FLCs at MCCSS. Assignment to the additional duty is performed from this available pool by the staff of ELR. The assignment is made based on a loose, informal prioritization process based on the number of classes a course executes in a year. While the staff of ELR possesses each FLC’s class schedule, these class schedules are not used to shape temporary duty assignments. Consideration is not given to when the next class of a course is due to convene, how many students bound to a specific course are among the available ELR pool or already queued at an FLC, or other potential factors relative to efficient class convening dates.

This extra duty assignment becomes a bottleneck when it assigns students to 3 weeks of duty, during which time they could have been attending a class in their assigned course track. To illustrate potential financial costs of this additional duty assignment, the following set of assumptions and calculations is presented. The Department of Defense

(DoD) realizes costs in addition to basic pay for military personnel. These additional costs include retired pay accrual, retiree health care, basic allowance for housing and basic allowance for subsistence. To provide budget planners with a planning figure for personnel costs, the Office of the Under Secretary of Defense, Comptroller, publishes an annual memorandum containing the military composite rates, the planning figure used to calculate aggregate manpower costs. Military composite rates are presented by service, by rank. For financial calculations presented here, the Marine Corps fiscal year 2010 composite rate for the rank of E2, Private First Class, is used. This rate is \$46,421. An interpretation of this is that the Marine Corps programmed \$46,421 of its personnel budget per E2 in its inventory. (DOD Military Composite Standard Pay and Reimbursement Rates, Fiscal Year 2010, 2009, p. Tab K-4) The rank of E2 was used as an assumed average of ranks at this point in the EELT pipeline. Calculations are based on an average work year that contained 48 weeks in which a Marine could perform work. Forty-eight weeks represents the average of 52 weeks in a year minus a Marine's annual leave entitlement of 4 weeks. Based on a 48-work-week year and a composite rate of \$46,421, the weekly "cost" of the average student within the EELT pipeline is \$967. Each week of assignment for a Marine to MCCSSS' temporary results in a cost of \$967 if that student could otherwise have attended his assigned course.

The weekly "cost" presented above represents a negative cost to the EELT pipeline if the Marine assigned to the temporary extra duty is actually foregoing an otherwise available class seat, i.e., the "cost" is not realized if the Marine would have had to wait for the available class seat in order to begin training in his assigned course. An assumption of this analysis is that not all of the 91 students assigned to the temporary extra duty are foregoing available class seats. Tables 10 and 11 present a spectrum of potential costs of student assignment to the temporary extra duty in week delay increments.

		10%	33%	67%	100%	
Costs (per noted period)		1	9	30	61	91
Delay Time (in Weeks)	1	\$967	\$8,704	\$29,013	\$58,993	\$88,006
	2	\$1,934	\$17,408	\$58,026	\$117,987	\$176,013
	3	\$2,901	\$26,112	\$87,039	\$176,980	\$264,019

Table 10. Weekly Cost of Assignment to Temporary Additional Duties, Fiscal Year 2010

		10%	33%	67%	100%	
Annual Costs (17 total 3 week cycles)		1	9	30	61	91
Delay Time (in Weeks)	1	\$16,441	\$147,967	\$493,223	\$1,002,887	\$1,496,110
	2	\$32,882	\$295,934	\$986,446	\$2,005,774	\$2,992,220
	3	\$49,322	\$443,901	\$1,479,669	\$3,008,661	\$4,488,330

Table 11. Annual Cost of Assignment to Temporary Additional Duties, Fiscal Year 2010

Table 10 shows a variety of potential costs of the temporary duty assignment for an individual 3-week cycle. The per student cost increments are in terms of 1 student, 9 students or 10% of the potential billets, 30 students or 33% of the potential billets, 61 students or 67% of the potential billets, or 91 students, which present 100% of the potential billets. The time periods are represented in weekly increments during which a student is actually foregoing an open class slot, 1, 2, and 3, respectively. For example, the total cost to the EELT pipeline for the assignment of 1 student to temporary extra duties, during which time he is delayed for 2 weeks' worth of EELT pipeline progress, is \$1934. Another example presented in Table 10 is the total cost to the EELT pipeline for the assignment of 67 students to temporary extra duties, during which they all are delayed 3 weeks' worth of EELT pipeline progress is \$176,980. To repeat an earlier qualifier, these costs are only experienced if there is actual loss of progress in transit through the EELT pipeline, i.e., if actual available slots for these students go unfilled in their assigned courses.

Table 11 presents the same calculations as presented in Table 10 expanded to the entire fiscal year. The student cost increments and weekly increments in Table 11 are the same as in Table 10, however, the sum total has been multiplied by 17 to account for the entire year. There are approximately 17 total 3-week cycles in a year. For example, if there is an annual average of 10% of the temporary additional duty work force that is delayed 1 week in EELT pipeline transit, the total cost is \$147,967. If an annual average of 67% of the temporary additional duty work force is delayed 2 weeks in EELT pipeline transit, the total cost is \$2,005,774. As Table 11 reveals, costs of delayed transit times quickly rise when viewed on an annual basis.

To add depth to this analysis, in fiscal year 2010 classes for the Administration Clerk (an input to the Administrative Specialist Course for fiscal year 2011) convened roughly every 2 weeks. This is a generalization for illustrative purposes; in actual execution, there was variability in the time between class starts. Class utilization rates for each trimester were 90.28% for the ONDJ trimester, 94.00% for the FMAM trimester, and 95.83% for the JJAS trimester, as depicted in Table 9. These rates signify that

although the classes executed for this course were close to capacity, there was some slack in many classes for this course. The presence of a single Marine per 3-week period assigned to ASC that misses a single class start results in an average delay of 2 weeks for 17 Marines. The total cost of this delay is \$32,882 (\$967 per week * 2 weeks * 17 3-week cycles ~ \$32,882 rounded). Additional Marines assigned to MCCSS's extra duties while unfilled open class capacity exists in their assigned courses results in additional unnecessary wait time and incurs additional costs.

ELR has demonstrated flexibility in their assignment process and is willing to drop individuals from the temporary duty. However, any individual dropped from extra duties and released to a FLC requires a replacement from another source, thereby maintaining the total 91 member duty force. FLCs interviewed for this report only requested replacement of their personnel in cases where specific classes would be canceled without the student, not to fill unused capacity in classes that met the minimum class size requirement. This represents a lost opportunity to maximum class utilization and to minimize delay time and lower costs.

2. Training Input Plan

The Training Put Plan (TIP) was introduced in Chapter IV. FLCs use the forecasted throughput contained within each year's TIP as a guide when generating their annual course schedule and determining the allocation of course resources. As directed in the Training Input Plan Reference Guide (Training Command, 2009b), a user's guidebook that describes the TIP process, defines associated terminology, and provides guidance for operation, FLCs "must strive to train to the stated requirement" (p. 10). This stated requirement is the throughput forecast by trimester. As such, the TIP can be seen as directive in nature, requiring each FLC to schedule its class offerings to facilitate the specific trimester throughput forecasts. As revealed in the discussion of the Artillery Electronic Maintenance Course's forecast error percentage for FMAM and JJAS 2010, significant

deviations from the forecasted throughput can create opportunities for less than optimum efficiencies in FLCs student throughput flow. This flaw in the system can be realized in one of two ways.

The duration of Artillery Electronics Maintenance Course is long in relation to other classes in this study, consisting of a total of 135 training days. As such, individual classes may be executed within two consecutive trimesters, as is the case with the second and third classes of this course in fiscal year 2010. Course schedule developers at MADFS scheduled two classes of this course in the FMAM trimester, which actually resulted in effective utilization of actual throughput. However, schedule planners strictly following the directives of the TIP Reference Guide could have reasonably scheduled one class of the Artillery Electronics Maintenance Course in each trimester of fiscal year 2010. This result would have resulted in delay time experienced by students traveling through EELT pipeline within this specific track. This specific case study, made possible due to the unique nature of the small number of class offerings and low actual throughput of this course, reveal a potential friction point that may not be readily apparent in courses that offer a larger number of classes and have a higher actual throughput.

Another weakness exposed by this discussion is the difficulty in determining how to accurately interpret the TIP trimester forecast. This study classifies student throughput into trimesters by the convening date of the class each student graduates from. A portion of the rationale behind this particular method of classification is that FLC must actually allocate resources to a student upon that student's commencement of training. Therefore, a reasonable classification into trimester should be made in the trimester during which an FLC must devote these resources. However, in the previously discussed case of the Artillery Electronics Maintenance Course, the large majority of the training for the third class in fiscal year 2010 actually occurred in the JJAS trimester, not the FMAM trimester in which the students were classified for this report. This phenomenon causes difficulty and exposes a weakness not only for the methodology used for this report, but for the accurate use of the TIP forecast by schedule planners. The difference in how to classify

these students may seem to be a slight, semantic debate; however, it is a substantial issue for FLCs in their planning processes and predicted resource allocation. Critical judgment and consideration of historical trends inform the decision making of these planners; however, at the most basic level of execution, the Marine Corps expects each FLC to plan for and to be prepared to execute the level of throughput directed by the TIP forecasts. As the previous forecast error percentage reveals, there is a degree of inaccuracy to those forecasts.

3. Marine Corps Training Information Management System

As introduced in Chapter IV, the Marine Corps Training Information Management System (MCTIMS), a web-based information technology system, is a significant component of the EELT pipeline process. A portion of MCTIMS' functionality allows FLCs to track inbound students and record historical class throughput information, such as class completion rosters, class schedules, and class seat allocation. After the TIP is published in a fiscal year, FLCs typically have a calendar month in which to generate the class schedule for each of their courses. Each FLC typically generates these schedules using the trimester throughput forecasts contained within the TIP as well as subjective judgment based on execution of previous years. After each FLC generates the class schedule for each of its courses, these schedules are approved and entered into MCTIMS. From this point forward, authorized users, such as administrative staff at various EELT nodes like the two Marine Combat Training (MCT) battalions or individual FLCs, have the ability to register individual students into specific classes. Once a student is registered for a class, all MCTIMS users authorized to view this portion of MCTIMS can view this information and anticipate arrival windows for individuals and utilization rates of specific classes.

Anecdotal data collected from each of the four FLCs interviewed for this report revealed a trend of user level dissatisfaction with the reliability of the student registration information contained within MCTIMS, specifically the accuracy of inbound student throughput numbers and the effective time horizon that this data populates MCTIMS. All

FLCs in this study reported that individual class rosters for classes close to a student arrival window are significantly inaccurate, correctly forecasting the correct individual students and absolute number of students around 50% to 60% of the time. This particular flaw in the system is likely due to human error in MCTIMS entry procedures at multiple points within the EELT pipeline.

Another potential friction point is that most students cannot be registered for their specific MOS producing course until their classification of occupational specialty, which typically occurs late in Recruit Training or while a student undergoes training at one of the MCT battalions. This procedural bottleneck means that, under optimum conditions, individual students typically cannot be registered for a class until just prior to their arrival at an FLC, usually 2 to 3 weeks in advance. This lack of lead time creates difficulties for FLCs because that they have inadequate lead time to adjust to periods of significant variation from the predicted level of throughput originally contained in the TIP document for that fiscal year.

4. Information Technology Interoperability

The previous section described MCTIMS and the Marine Corps' use of it in the EELT pipeline. The Army uses a different web-based information technology system to provide similar functionality in its training pipeline. This system is the Army Training Resources and Requirements System (ATRRS). According to Army Regulation 350-10, ATRRS, among other functionalities, "provides the capability to manage the Army's Institutional training program for all courses of instruction" (p. 9). All units that reside on Army installations, regardless of service, are required to use ATRRS to plan, schedule, and track student throughput. As such, both MADFS and MTIC are required to use ATRRS to answer their installation hosts' requirements as well as MCTIMS to answer their service requirements. Information exchange between the two systems is not complete, resulting in complicated localized processes that each FLC uses to successfully accomplish this task. These processes add an additional administrative burden on these FLCs and introduce an additional opportunity for friction within the EELT pipeline.

One example of interoperability friction revealed is the annual class scheduling process. ATRRS will push schedule information to MCTIMS; however, MCTIMS will not push schedule information to ATRRS. So, to overcome this problem, while in their annual schedule development phase, both MADFS and MTIC input their class schedules into ATRRS, not MCTIMS. ATRRS then pushes the FLCs' schedules back into MCTIMS. As Marine FLC staff members are typically not given user access rights to ATRRS, this process usually involves delivering a locally produced paper schedule to an Army service member with ATRRS user access to input. This additional layer of human interaction only increases the potential for error.

Another example of increased potential for error is class rosters. FLCs track and maintain student rosters within MCTIMS. As noted, MCTIMS does not possess the capability to push information to ATRRS. These rosters, once confirmed by each FLC, must also be maintained in ATRRS. Similar to the scheduling process discussed above, this task is typically accomplished by generating a paper copy of a class roster and delivering this roster to the appropriate Army point of contact for entry into ATRRS.

The lack of complete interoperability between ATRRS and MCTIMS creates an additional administrative burden on staffs of FLCs assigned to Army installations. Additionally, the additional steps required to overcome this process flaw introduces additional opportunities for friction within the EELT pipeline.

5. Course Descriptive Data

Each FLC within the EELT pipeline is required to maintain a document called the Course Descriptive Data (CDD) for each of its courses. According to Marine Corps Order 1532.2A, Management of Marine Corps Formal Schools and Training Detachments, this document contains at least 24 specific pieces of information pertaining to course material requirements, educational learning objectives, class capacity recommendations, and class length. These CDDs are directive in nature as to the execution of classes within a formal school.

This research revealed at least one CDD, the Field Artillery Firefinder Radar Operator CDD, which is outdated in relation to the current execution of the course. Most of the courses at MADFS were once joint courses between the Marine Corps and the Army, and as such, relied on Army generated Periods of Instructions. However, due to divergent equipment requirements, each course, including the Field Artillery Firefinder Radar Operator Course, has shifted to a Marine led course. The current CDD used for this course is an Army Period of Instruction document dated 14 December 2004 and does not reflect the latest information pertaining to this course.

D. SUMMARY

This chapter provided quantitative and qualitative analysis of the four FLCs researched for this report. A comparison of maximum available course capacity and actual throughput revealed that most courses within this report are operating at less than full capacity, although that may not be the most accurate measure of effectiveness in absolute terms. Calculations for course utilization revealed that most courses are scheduling an appropriate number of classes to meet their administrative requirements as directed in the CDDs. Utilization of these classes presented a cyclical pattern, with a high utilization rate in the ONDJ trimester and declining utilization rates within the FMAM and JJAS trimesters. The quantitative analysis concluded with an in-depth analysis of the accuracy of the TIP forecasting process, with varying results throughout the courses in each trimester. The qualitative analysis provided insight into potential process friction points within the ELR extra duty assignment process, the TIP trimester forecasting process, difficulties experienced with the MCTIMS and ATRRS information technology systems, and the currency of CDDs. Each of these potential friction areas introduces opportunities for process inefficiency and error.

The next chapter will present a summary of this report, conclusions based on the analysis conducted, and recommendations for process improvement within these FLCs and the EELT pipeline.

VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

This report is an analysis of four Formal Learning Centers (FLC) within the Marine Corps Enlisted Entry-Level Training (EELT) pipeline. The EELT pipeline is a multi-node, multi-process transformational system in which Marine accessions are trained and qualified within their assigned Military Occupational Specialty (MOS) in support of their unit's table of organization. Each node of this system depends on the output of multiple additional nodes. Major processes that support the EELT system include manpower end-strength planning, Training Input Plan (TIP) student throughput forecasts, and information sharing supported by the Marine Corps Training Information Management System (MCTIMS). Each FLC uses the output of the TIP to generate its annual schedule of class offerings for each of its courses.

Four of these FLCs, Personnel Administration School (PAS), Financial Management School (FMS), Motor Transport Instructor Company (MTIC), and Marine Artillery Detachment, Fort Sill (MADFS), train and qualify assigned Marines to perform specific MOS duties. For fiscal year 2010, each of these courses operated below its capable capacity in terms of possible student throughput. Additionally, the average class trimester utilization rates peaked in the first trimester of fiscal year 2010 and subsequently fell during the second and third trimester. There was significant variation between the student throughput forecasts published by the TIP and the actual student throughput executed for the same time period.

Additional system inefficiencies in the EELT pipeline affected the FLCs' ability to operate at an optimum level. Entry Level Receiving's temporary additional duty assignment processes introduced the opportunity for unnecessary delays for students assigned to PAS and FMS. Student registration accuracy and timeliness within MCTIMS negatively impact all FLCs within this report. The lack of interoperability between MCTIMS and the Army Training Resources and Requirements System appear to have

caused a less than optimal environment, creating a potential for errors and additional administrative burdens for MTIC and MADFS.

B. CONCLUSIONS AND RECOMMENDATIONS

Based on the observations and analysis in this report, the following conclusions and recommendations are provided.

1. Entry-Level Receiving

a. Conclusion

The process Entry-Level Receiving, Marine Corps Combat Service Support Schools, uses to assign students to its 3-week temporary additional duties requirement³ is not efficient. The existing assignment process does not take advantage of opportunities to apply critical judgment in differentiating among candidate's potential class start dates, existing course queuing levels, or throughput optimization. The current process results in inefficient assignments that delay progress through the EELT pipeline, increase non-value-added time, and represent significant potential for increased manpower and financial costs. An analysis of these potential costs was presented in Chapter V.

b. Recommendation

(Marine Corps Combat Service Support Schools) **Formalize the Entry-Level Receiving assignment process.** The development and implementation of an optimization model to assist in the assignment of students to the temporary extra duty

³ An actual cost benefit analysis of the actual existence of the 91-billet temporary additional duty requirement is outside the scope of this report. The existence of this force does come at a cost to the EELT pipeline unless 100% of the students assigned to it are unable to fill a class seat in their assigned course for the entirety of their three week assignment to the billet. The purpose of this recommendation is to propose a method to lessen the overall impact this requirement has on overall transit times within the EELT pipeline and to expose potential costs of the assignment, not to justify the abolishment of this requirement.

assignment would potentially reduce excess EELT pipeline transit delay and reduce associated costs. An optimization linear programming model with the following characteristics is recommended:

- A set of binary (Yes / No) decision variables indicating assignment / nonassignment to temporary extra duty per student
- An objective function that minimizes total delay time experienced by students
- Constraints that include factors such as all future scheduled class start dates for each course, existing number of students currently queued for each course, and maximum class capacity for each class.

The development and testing of such an optimization model could be developed at no cost by a student at the Naval Postgraduate School, Monterey, California. Additionally, the implementation of this model would require a localized change within MCCSSS and would not require major policy or procedural changes elsewhere within the EELT pipeline.

2. Annual Course Capacity

a. Conclusion

The Financial Management Resource Analysis Course (FMRAC), Basic Finance Technician Course (BFTC), Cannon Crewman Course, Artillery Fire Controlman Course, Artillery Electronic Maintenance Course, and Motor Vehicle Operator Course (MOVOC) all operate at levels significantly below their available capacity, as identified in the Course Descriptive Data.

The High Mobility Artillery Rocket System (HIMARS) Operators Course and Artillery Firefinder Radar Operator Course both operate at levels significantly above their maximum capacity, as identified in the Course Descriptive Data.

b. Recommendation

(Training Command) **Direct a study of courses with either significantly high or low capacity utilization rates to identify if these courses experience the same capacity utilization rates over multiple fiscal year periods.** If actual capacity utilization rates are found to be significantly different than existing course capacity levels, reallocate resources to compensate for the higher or lower utilization levels.

3. Class Utilization Rates

This analysis showed that class utilization rates in this sample of the EELT pipeline were the highest in the October, November, December, January (ONDJ) trimester and fell progressively through the remaining two trimesters of fiscal year 2010.

4. Throughput Forecast Error

a. Conclusion

The throughput forecast errors and throughput forecast error percentages show that the Training Input Plan (TIP) did not accurately forecast the actual annual throughput for the FMRAC, BFTC, HIMARS Operators Course, Artillery Electronics Maintenance Course, and MOVOC in fiscal year 2010. Additionally, the same calculations show that the TIP did not accurately forecast the actual trimester throughput for the FMRAC, BFTC, Cannon Crewman Course, HIMARS Operators Course, Artillery Firefinder Radar Operator Course, Artillery Scout Observer Course, Artillery Electronic Maintenance Course, MOVOC, and Logistics Vehicle System Operator Course.

Improved trimester TIP throughput forecasts would allow the generation of more accurate annual course schedules and could enable class utilization rates to increase. Increased class utilization rates could potentially result in an overall reduction in the total number of classes scheduled, thereby reducing the structural overhead required at each FLC. Some throughput forecast error is unavoidable due to the sheer

magnitude and volume of throughput within the EELT pipeline; however, any improvement in the processes that support a system of this size will lead to efficiencies and savings of a like magnitude.

b. Recommendation

(Formal Schools Training Division) **Improve processes used to generate Training Input Plan annual and trimester throughput forecasts.** Direct a study to determine the underlying causes for throughput forecast errors for courses experiencing throughput forecast error percentages in excess of 20 percentage points, i.e., throughput forecast error percentages less than 80% or greater than 120%. Upon determination of these underlying causes, incorporate measures to mitigate their effect into current forecasting techniques.

5. Marine Corps Training Information System

a. Conclusion

FLC users report dissatisfaction with the Marine Corps Training Information System (MCTIMS) for two reasons. The first reason is that the lead time on available student registration information is insufficient to allow adequate flexibility in schedule and resource allocation adjustment. The second reason is that the reliability of student registration information is inaccurate. The full potential of MCTIMS is not currently being optimized within the EELT pipeline. While the timeliness of student class registration is a negative by-product of the current system of the Military Occupational Specialty (MOS) classification system, i.e., a Marine is not typically assigned a MOS until shortly before being sent to his first FLC for MOS training, more accurate and timely registration of each student Marine in the appropriate class would allow FLCs a modicum of flexibility and responsiveness to unforeseen changes in forecasted student throughput.

b. Recommendation

(Training and Education Command) **Develop, validate, and institute reportable measures of effectiveness (MOE), specifically targeted at timely and accurate student class registration.** MOEs pertaining specifically to timely and accurate student registration within MCTIMS should be assigned within the Marine Corps Automated Inspection Reporting System (AIRS) and inspected no less than annually for major subordinate commands within the EELT pipeline.

6. Information Technology Systems Interoperability

a. Conclusion

The identified lack of interoperability between MCTIMS and the Army Training Resources and Requirement Systems (ATRRS) creates administrative burdens and potential process weaknesses for the Marine Artillery Detachment, Fort Sill and for the Marine Detachment, Fort Leonard Wood. While this report revealed this complication within only two FLCs, it is assumed that this lack of interoperability exists at each of the Marine Detachments resident aboard Army installations. The limited ability of ATRRS to push information to MCTIMS reveals that a limited capacity for information exchange currently exists. Increased levels of interoperability between the two systems will increase opportunities for improving class utilization and reduce potential delays caused by misinformation.

b. Recommendation

(Training and Education Command) **Improve interoperability between the Marine Corps Training Information System and the Army Training Resources and Requirements System.**

C. RECOMMENDATION FOR FURTHER RESEARCH

To sustain process improvement, the following recommendation for potential future research topics is provided.

- (Training Command) Direct further studies to develop an optimization model that includes each course present within the Training Command portion of the EELT that minimizes student queuing time, given the current level of resources and class constraints as contained within the relevant Course Descriptive Data.

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